1910A/1911A
Multi-Counters

Instruction Manual

FLUKE®

1910A/1911A
Multi-Counters

Instruction Manual

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FLUKE®

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*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

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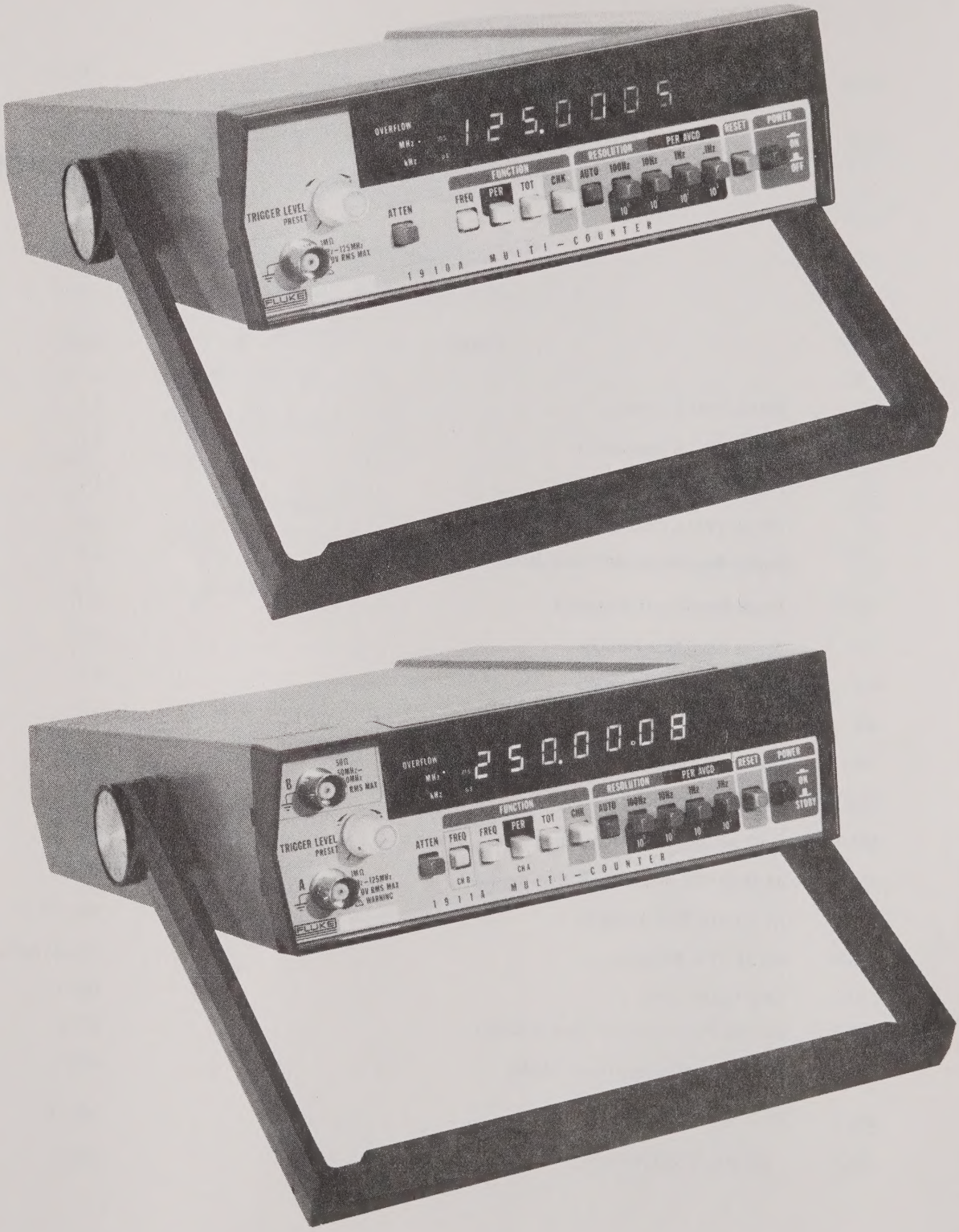


1910A/1911A Multi-Counters

Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. This manual has been designed such that the information presented will pertain to two similar multi-counters, the 1910A and the 1911A. Any information, figures, tables, or general data that is unique to either one or the other, but not both will be denoted with the model number of the instrument that the information pertains to.

NOTE

The BNC input connector on the model 1910A has no channel designation. Its operation is identical to the 1911A channel A BNC input connector and will be referred to as channel A throughout this manual.

1-3. The measurement display of both units uses light-emitting-diodes (LED's) to illuminate 7 display digits and three annunciators. The annunciators are provided to indicate measurement units (kHz, MHz, msec, and usec) and an overflow indication when the capacity of the display is exceeded. The counter uses 0.3 inch high display LED's with leading zero suppression and automatic decimal positioning to assure fast and accurate reading.

1-4. A self-check mode of operation is provided on the counter to verify operation of every section but the pre-amplifiers and the time base itself. To insure precise triggering, the counter is equipped with an approximate 10:1 attenuator for high level inputs or high noise environments. It also utilizes a variable trigger level, which may be adjusted to assure stable triggering or left at the preset value.

1-5. Several options and accessories are available for use with the 1910A and 1911A. The options are listed in Table 1-1, and must be specified at the time of purchase. Table 1-2 lists the available accessories. The accessories are compatible with all options and may be ordered at the time of purchase or later. Detailed information concerning each option and accessory is given in Section 6 of this manual.

Table 1-1. 1910A/1911A Options

OPTION NO.	DESCRIPTION
01	Battery Power Supply
02	Data Output Unit
03	TCXO, 10 MHz, 2 PPM
04	TCXO, 10 MHz, 0.5 PPM

Table 1-2. 1910A/1911A Accessories

ACCESSORY MODEL NO.	DESCRIPTION
MOO-100-714	Dust Cover
MOO-200-611	Offset Rack Adapter
MOO-200-612	Center Rack Adapter
MOO-200-613	Dual Rack Adapter (For two 1910A's/1911A's or one 1910A/1911A with either an 8000A or 8600A).
C-80	Vinyl Case Cover with Accessory Pouch
C-86	Carrying Case (For a single 1910A/1911A)
C-85	Dual Carrying Case (For two 1910A's/1911A's or a 8000A or 8600A)
A-53	Telescope Whip Antenna

1-6. Model 1910A Characteristics

1-7. The Model 1910A is a Digital Multi-Counter capable of making 3 basic measurements: frequency, period, and totalize, over a 5 Hz to 125 MHz range for the frequency mode, and 5 Hz to 2 MHz in the period mode. Resolution of the period and frequency modes may be manually selected from four ranges (resolution in the totalize mode is unnecessary). In the frequency mode the four ranges of resolution are: 0.1 Hz, 1.0 Hz, 10 Hz, and 100 Hz; while in the period mode there are 10^0, 10^1, 10^2, and 10^3 periods averaged. In conjunction with the four manual resolution selections the counter provides an autorange circuit which, when activated, optimizes the three lowest resolutions (1.0, 10, and 100 Hz) by seeking to fill all dis-

play digits. The highest resolution range (0.1 Hz) must always be manually selected. In the period mode autorange will select 10^0, 10^1, 10^2, 10^3, and 10^4 periods averaged in seeking to fill all display digits.

1-8. Model 1911A Characteristics

1-9. The Model 1911A is also a Digital Multi-Counter capable of making not only the measurements of the 1910A, but its input range has been expanded with the addition of a prescaler and an input channel B to cover the 50 MHz to 250 MHz spectrum in the frequency mode.

1-10 SPECIFICATIONS

1-11. Specifications for the 1910A and 1911A are presented in Table 1-3. Those places where specifications do not apply to both instruments have been marked.

Table 1-3. 1910A/1911A Specifications

OPERATING RANGES

FREQUENCY CHANNEL A	5 Hz - 125 MHz
FREQUENCY CHANNEL B (1911A ONLY)	50 MHz - 250 MHz
PERIOD CHANNEL A	5 Hz - 2 MHz
TOTALIZE CHANNEL A	1 COUNT TO 9999999

TIME BASE

	Standard	–03 Option	–04 Option
FREQUENCY	10 MHz	(2 ppm TCXO) 10 MHz	(0.5 ppm TCXO) 10 MHz
AGING RATE	$\pm 5 \times 10^{-7}$ /mo	$\pm 3 \times 10^{-7}$ /mo	$\pm 3 \times 10^{-7}$ /mo
TEMPERATURE DEPENDENCE	0 to 50°C $\pm 5 \times 10^{-6}$	$\pm 2 \times 10^{-6}$	$\pm 3 \times 10^{-7}$
	20 to 30°C	$+1 \times 10^{-6}$ (typ)	
LINE VOLTAGE DEPENDENCE FOR ± 10% CHANGE	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$

CHARACTERISTICS (ELECTRICAL)

CHANNEL A	
INPUT IMPEDANCE	1M ohm shunted by less then 30 pf, AC coupled.
SENSITIVITY	15 mV rms: 5 Hz to 100 MHz 25 mV rms: 100 MHz to 125 MHz
ATTENUATOR	Decreases sensitivity by approximately 10.
TRIGGER LEVEL	±0.5 V
OVERLOAD LEVEL	DC + AC: Less than 360V peak. AC: 250V rms 5 Hz to 1 kHz. 10V rms above 1 kHz. (30V peak when operating from Batteries)
CHANNEL B (1911A ONLY)	
INPUT IMPEDANCE	50 ohms nominal. VSWR less than 2.5:1
SENSIVITY	Less than 15 mV rms: 50 MHz to 175 MHz Less than 30 mV rms: 175 MHz to 250 MHz
OVERLOAD	DC + AC: Less than 100V peak (30V Peak when operating from batteries). AC: 5V rms, fuse protected.

Table 1-3. 1910A/1911A Specifications (Continued)

EXTERNAL TIME BASE INPUT

FREQUENCY REQUIRED	10 MHz
SENSIVITY	300 mV rms
INPUT IMPEDANCE	Greater than 1k ohm
MAXIMUM INPUT	5V pk-pk

RESOLUTION

FREQUENCY — Four manually selected resolutions of 100 Hz, 10 Hz, 1 Hz and .1 Hz.

Autorange will automatically seek to fill all seven digits but will not select a resolution better than 1 Hz.

PERIOD — Manual selection provides single period measurement, or the averaging of 10^1, 10^2, or 10^3 periods.

10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange will automatically seek to fill all seven digits and, if the input frequency is high enough, may select 10^4 periods averaged (10 ps resolution), but will not select a gate time greater than 1 sec.

TOTALIZE — Accumulates up to 9999999 counts then reset to zero and activates overflow indicator.

GENERAL

DISPLAY — 7 digit LED, Leading zero suppression.

ANNUNCIATION — MHz, kHz, msec, usec, overflow

Time between successive measurements is 200 ms nominal plus measurement time.

AUTORANGE — In both frequency and period modes autoranging includes a unique 20% hysteresis in its switching threshholds to eliminate redundant up range/down range commands. This allows measurement to be made on signals containing large amounts of FM and PM. Hysteresis can be reset by depressing reset button.

AUTORESET — A new measurement sequence is started every time a front panel push button is activated except the attenuator.

OPERATING TEMPERATURE
1910A/1911A: 0°C to 50°C
1910A/1911A-01: 0°C to 40°C if operating from line.

STORAGE TEMPERATURE
1910A/1911A: –40°C to +70°C
1910A-01/1911A-01: –40°C to +60°C

Table 1-3. 1910A/1911A Specifications (Concluded)

POWER REQUIREMENTS	1910A/1911A:	100/115/230 ±10%, 48 - 440 Hz, 8W max.
	1910A/1911A/1911A-01:	100V ±10%, 48 - 52 Hz
		100V ±10%, 58 - 62 Hz
		115V ±10%, 58 - 62 Hz
		230V ±10%, 48 - 52 Hz, 8.5W max.

NOTE! Voltage and frequency must be specified at time of order.

DIMENSIONS	Width:	8.55 inches	217.2 mm
	Height:	2.52 inches	64 mm
	Depth:	10.65 inches	271.0 mm

WEIGHT	1910A/1911A:	3.2 lbs max.	1.5 kgm max.
	1910A-01/1911A-01:	4.8 lbs max	2.2 kgm max.

OPTION –01 (BATTERY)*

TYPE ..... Rechargeable Nicad

CHARGE TIME ..... 16 hrs with power switch off at less than 30°C.

OPERATING TIME ..... 4 hrs minimum (Battery capacity reduced if charged at greater than 30°C.).

OPTION –02 (DATA OUTPUT)*

DATA OUTPUTS ..... 7 digits with overflow decimal and units information in BCD parallel/digit serial format at CMOS levels.

OTHER INPUTS ..... 7 digit strobe signals. Update signal, leading zero suppression signal.

TCXO

TIME BASES ..... (See time base characteristics for detail specifications)

OPTION –03 ..... 2 ppm TCXO
OPTION –04 ..... 0.5 ppm TCXO

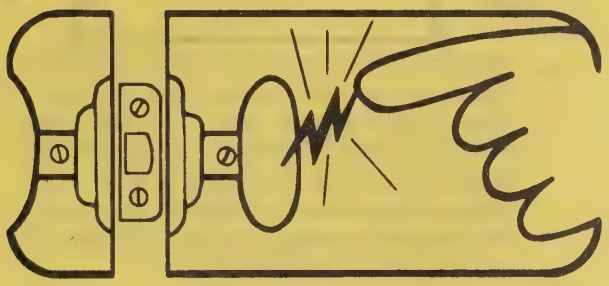
Note! All options must be installed at time of ordering. No options are field installable.

**Due to space limitations within the instrument the 1910A and 1911A may be ordered with either option, –01 or –02, but not both options.*

static awareness

A Message From

John Fluke Mfg. Co., Inc.

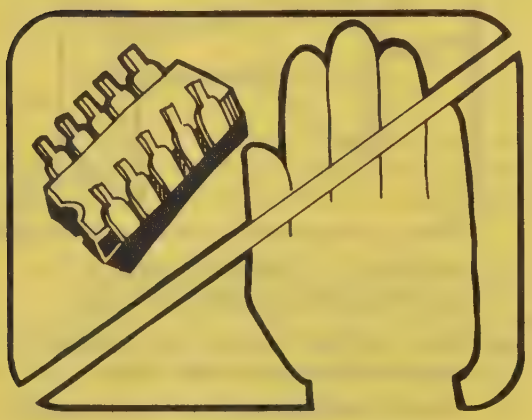


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

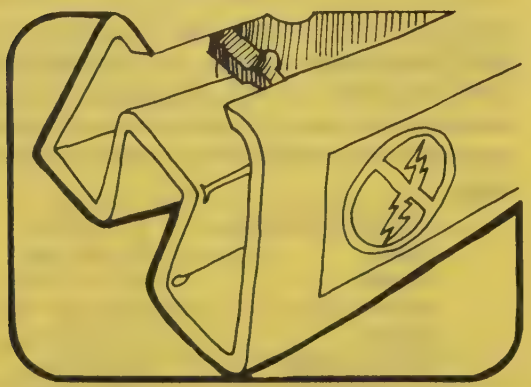
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

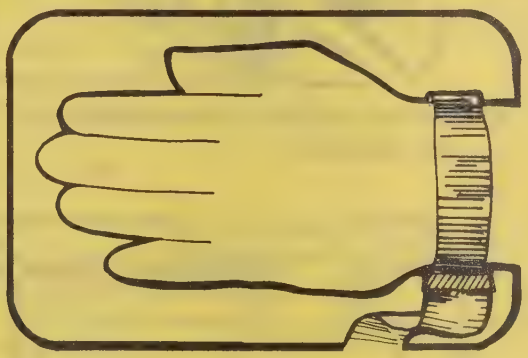
The following practices should be followed to minimize damage to S.S. devices.



1. MINIMIZE HANDLING

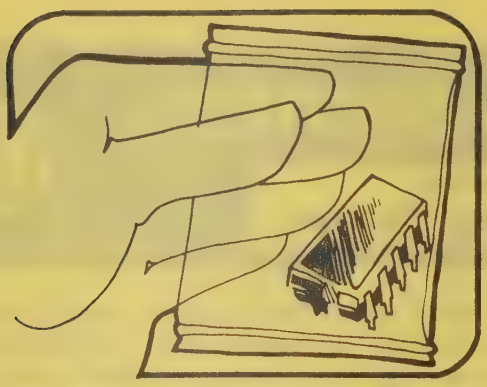


2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.

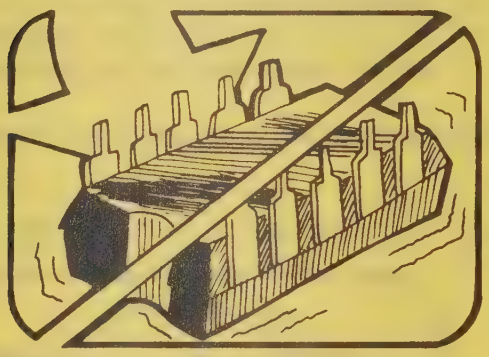


3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES

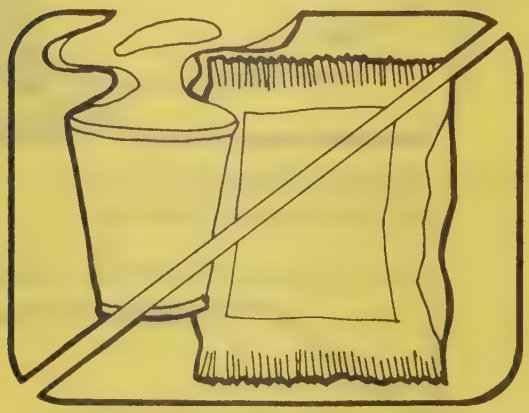
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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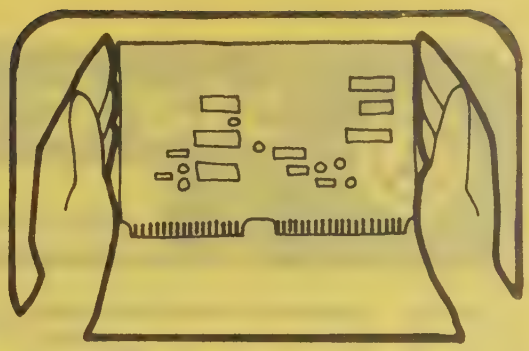
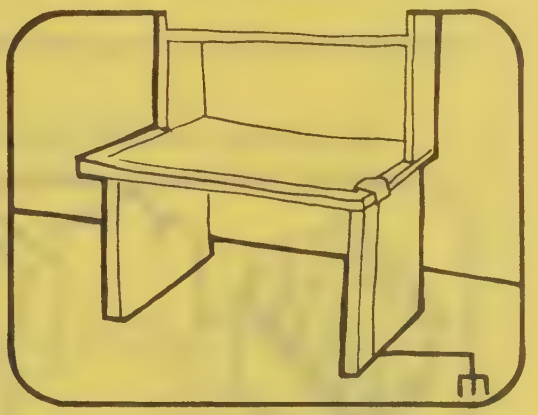


8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet 30"x60"x60 Mil P/N RC-AS-1200 $20.00	Wrist Strap P/N TL6-60 $7.00

® Dow Chemical

J0089B-07U7810/SE EN Litho in U.S.A.

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding the installation and operation of the Model 1910A and 1911A. The contents of this section should be read before operating the instrument. Should any difficulties be encountered during operation, please contact your nearest authorized John Fluke Technical Service Center. A list of Technical Service Centers is located in Section 7.

2-3. SHIPPING INFORMATION

2-4. The counter is packaged and shipped in a protective container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co. Please reference the equipment model number when requesting a new shipping container.

2-6. INPUT POWER, LINE

2-7. The counter has three available input power configurations: 100V, 115V, and 230V, all compatible with line frequencies between 48 and 440 Hz. See Section 6 for battery power requirements.

NOTE

A decal on the bottom of the instrument indicates the AC line voltage and frequency the instrument will operate from.

2-8. RACK INSTALLATION

2-9 The 1910A/1911A is designed for either bench top use or for installation in a standard 19-inch equipment rack, using an optional accessory rack mounting kit. Rack mounting kits are available for left, right, center, or side-by-side mounting of the 1910A/1911A. Installation information of the rack mounting accessories is given in Section 6, under Rack Installation.

2-10. OPERATING FEATURES

2-11. The location and function of all controls, connectors, and indicators are shown in Figure 2-1, and defined in Table 2-1.

2-12. OPERATING NOTES

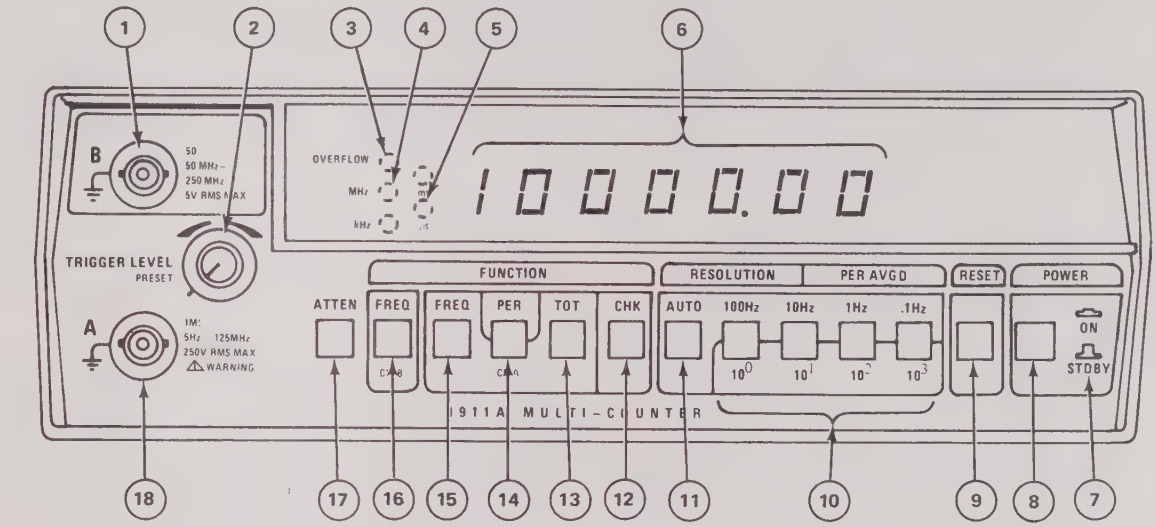
2-13. Fuse

2-14. The line fuse, F1, is located on the instrument rear panel, (see Figure 2-1), the fuse required is an AGC 1/8 amp slow blow, for 100V and 115V line, 1/16 amp slow blow for 230V line, and a ½ amp slow blow for all battery configurations.

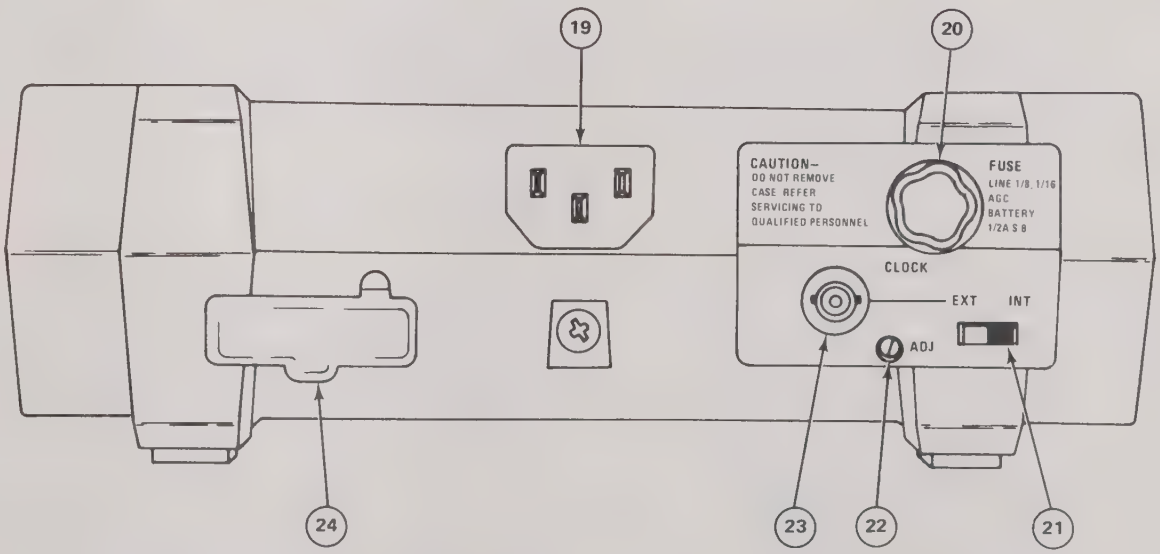
2-15. Input Connection

2-16. Signals to be measured by the Model 1910A are applied to the front panel BNC connector. Connection of all input signals should be by means of coaxial-type cable fitted with a mating BNC connector. Input impedance is 1 megohm shunted by less than 30 pF, AC coupled.

2-17. Signals to be measured by the Model 1911A may be applied to either the designated channel A front panel BNC connector for inputs between 5 Hz and 125 MHz, or to the designated channel B front panel BNC connector for inputs between 50 MHz and 250 MHz. Connection of all input signals should be by means of coaxial-type fitted with a mating BNC connector. Input impedance is 50 ohms nominal on channel B.



FRONT PANEL



REAR PANEL

Figure 2-1. 1910A/1911A Control and Indicator Locations

Table 2-1. 1910A/1911A Control and Indicator Functions

Fig. 2-1. REF. NO.	NAME	FUNCTION
1	BNC Input Connector Channel B (1911A only)	Accepts input frequencies of 50 MHz to 250 MHz @ 5V rms max.
2	Triggering Level	Selects manual or preset triggering level of Channel A.
3	Annunciator	Overflow-lights to show count exceeds display capacity.
4	Annunciator	Illuminates to identify display units, MHz/ms.
5	Annunciator	Illuminates to identify display units, kHz/us.
6	Data Display	Seven LED Digits with leading zero suppression.
7	STDBY–01 Option	When power switch is in this position with the –01 option installed the unit is off but the batteries are still being charged (if unit is connected to the line).
8	Power Switch	Two position: in (unit on) out (unit off).
9	Reset Switch	Manually resets front panel & sequencer, U6.
10	Resolution Switches	Manually selects gate time; or period resolution.
11	Resolution Switch	Selects auto-range in freq. and period modes.
12	Function Switch	Selects self-check.
13	Function Switch	Selects totalize function, 1 count to 9999999.
14	Function Switch	Selects period function, 5 Hz to 2 MHz. (Channel A only)
15	Function Switch	Selects frequency function, 5 Hz to 125 MHz.
16	Function Switch Chan B, (1911A only)	Selects frequency function, 50 MHz to 250 MHz.
17	Attenuator Switch	Selects 10:1 attenuation for high level inputs on channel A.
18	BNC Input Connector Front Panel Chan A	Accepts input freq. of 5 Hz to 125 MHz.
19	3 Prong Connector	Provides connection for line voltage.
20	Fuse Holder	1/8, 1/16 Amp fuse, slow blow line versions. 1/2 amp fuse slow blow battery version.
21	Mode Switch	Selects reference frequency, internal or external.
22	Standard Time Base Y1 adjustment	Provides calibration adjustment of Y1 without removing unit from case.
23	Clock Input Connector	Provides input connection for 10 MHz clock signal.
24	DOU Output Connector –02 Option	Provides output connector for DOU data (in BCD serial format).

2-18. AC Line Connection

2-19. The input power cord is a three prong polarized connector which permits connection to all selected line configurations. Insure that the ground pin on the power cord is connected to a high quality earth ground.

2-20. Overload Protection

WARNING

THE OUTSIDE CONTACT OF THE INPUT BNC CONNECTOR IS TIED DIRECTLY TO EARTH GROUND THROUGH THE POWER PLUG. DO NOT CONNECT THE ACTIVE LEAD OF THE INPUT SIGNAL TO THE OUTSIDE CONTACT. IRREPAIRABLE DAMAGE TO THE COUNTER OR EQUIPMENT UNDER TEST MAY RESULT. TO MEASURE POWER LINE FREQUENCIES IT IS RECOMMENDED TO USE A STEPDOWN TRANSFORMER TO THE COUNTER INPUT.

2-21. The Model 1910A will accept inputs as high as 250 Vac rms at frequencies between 5 Hz and 1 kHz. At frequencies above 1 kHz the ac overload protection decreases to 10 Vac rms. The 1910A will withstand peak voltages, dc and ac up to 350V. On 1910A-01/1911A-01 instruments, operating from battery power, the input must be restricted to 30V peak. The Model 1911A will accept peak input voltages as high as 100V dc and ac on channel B.

2-22. Frequency Measurements

2-23. Perform frequency measurements as follows:

1. Depress the POWER switch to the ON position.
2. Depress the FREQ switch to select the frequency mode of operation.
3. Select the desired resolution, or the autorange mode by pressing the AUTO switch. If the input signal is completely unknown, the autorange mode will select the optimum range.

NOTE

In the autorange mode, automatic selection is made between the lower three resolutions. The 0.1 Hz resolution can only be manually selected, (by means of the 0.1 Hz resolution switch).

4. Connect the input signal to the front-panel BNC connector channel A. If the input is unstable due to noise the reading may improve by using the attenuator switch, and/or the trigger level adjustment.
5. Read the frequency on the display, and observe the unit of measurement indication, (kHz or MHz), to the left of the display.

2-24. Frequency Measurement, Channel B (1911A Only)

2-25. Perform the frequency measurement as follows:

1. Depress the POWER switch in (ON).
2. Select the frequency B mode of operation.
3. Select the desired resolution or autorange.
4. Connect the input signal to the front-panel BNC connector designated Channel B.
5. Observe that the display and the annunciators read correctly.

2-26. Period Measurement

2-27. Perform period measurement as follows:

1. Depress the POWER switch to the ON position.
2. Depress the PER switch to select the period mode of operation.
3. Select the desired number of periods to be averaged or the autorange mode by depressing the AUTO switch. If the input signal is completely unknown, the autorange mode will select the optimum number of periods to be averaged. The autorange mode will make selections between 10^0, 10^1, 10^2, 10^3 and 10^4 periods to be averaged.
4. Connect the input signal to the front-panel channel A, BNC connector.
5. Read the period time on the display.

2-28. Totalize Measurement

2-29. Perform the totalize measurement as follows:

1. Depress the POWER switch to the ON position.
2. Depress the TOT switch to select the totalize mode of operation, and the RESET switch to initialize the counter.
3. Connect the input signal to the front-panel BNC connector channel A.
4. Observe the display.

2-30. Self-Check Mode

2-31. The self-check mode provides a means of verifying proper overall operation of the counter, excluding: A and B input section and accuracy of time base. To self-check the unit proceed as follows:

1. Press the POWER switch to the ON position.
2. Press the CHK switch to select the self-check mode.
3. Press the 100 Hz RESOLUTION switch; the display should read 10.0000 MHz.
4. Press the 10 Hz RESOLUTION switch; the display should read 10000.00 kHz.
5. Press the 1 Hz RESOLUTION switch; the display should read 0000.000 overflow, kHz.
6. Press the 0.1 Hz RESOLUTION switch; the display should read 000.0000 overflow, kHz.
7. Press the AUTO switch; the display should read 10000.00 kHz.
8. Press the RESET switch; the display should read 88888.88.

2-32. Input Conditioners (Channel A)

2-33. The counter employs two input conditioners located on the front panel. One is the attenuator switch and the other is the adjustable triggering level.

2-34. The attenuator switch is a two position on/off switch used to decrease the input level by a factor of approximately 10. The attenuator obtains this factor by reducing the gain and increasing the hysteresis to the custom IC, U1.

2-35. The adjustable triggering level is used to bias the broadband amplifier, (contained in U1), at a preset value, or may be adjusted manually to compensate for noisy inputs or pulse measurement.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual is divided into two parts, Overall Block Diagram Description and Functional Block Diagram Description. Overall Block Diagram Description generalizes the operation of each section and explains its function with relation to all associated sections. Functional Block Diagram Description details individual section operation with reference to the controller (U6). Simplified block diagrams are referred to by figure number, and complete schematic diagrams are located in Section 8.

NOTE

Unless otherwise designated all information presented in this section pertains to both the Model 1910A and 1911A multi-counters.

3-3. OVERALL BLOCK DIAGRAM DESCRIPTION

3-4. Eight basic sections compose the circuitry of the Model 1910A and 1911A. They are: input section, power supply, time base, main gate, high speed dividers, accumulator (U7), controller (U6), and display. In addition to the eight basic sections the 1911A has a prescaler.

3-5. Frequency Mode (3.8 MHz Test Case)

3-6. To simplify the explanation of the overall circuit functions, assume that a 3.8 MHz signal has been applied to channel-A of the 1910A/1911A and that the 100 Hz resolution and frequency mode switches have been selected. The waveforms shown in Figure 3-1 give an exploded view of the information contained on a particular line for that instant of time. For a complete list of these waveforms see Section 6, Figure 602-1. It should be noted that Figure 3-1 is only an overall block diagram and will not be configured exactly the same for the different modes of operation (see Functional Block Diagram Description). However, since the frequency mode has been selected for this test case, Figure 3-1 will be referenced to in the following discussion.

3-7. For the frequency mode of operation the signal to be measured is applied to U1 which basically transforms it to standard ECL levels for application to the main gate. The ECL level will be passed to the high speed dividers for a time determined by the selected range. The high speed dividers then divide the unknown input to obtain the first and second digit information. This information is applied to the counters within U7 to obtain the rest of the digit information. The high speed dividers are necessary because the maximum toggle speed of the counters within U7 is 2 MHz. The digit information is strobed into the latches by a memory update signal (MUP) generated by the controller U6. U6 also applies a pulse simultaneously with the digit strobe to position the decimal and to light the appropriate annunciators. The latches (within U7) will hold and present the entire digit information to the display on a common data bus. U7 also generates the strobe cycle to enable the correct LED to light. Each LED is strobed individually for a period of 90 usecs. This individual strobe scheme increases the LED life and decreases the energy consumption, persistence of the eye eliminates any flicker.

3-8. In review of this test case it can be seen that to obtain a count in the frequency mode the 1910A/1911A has utilized all seven of it's basic sections. Each of these sections will be discussed in detail under the block diagram analysis. However, because one section, the controller, is basic to every other section and is essential to the operation of the 1910A/1911A in each mode of operation, it will be discussed now.

3-9. Controller (U6)

3-10. The controller (U6) is the basis of both the 1910A and 1911A multi-counters. Comprehension of its logic is necessary before proceeding to the other sections.

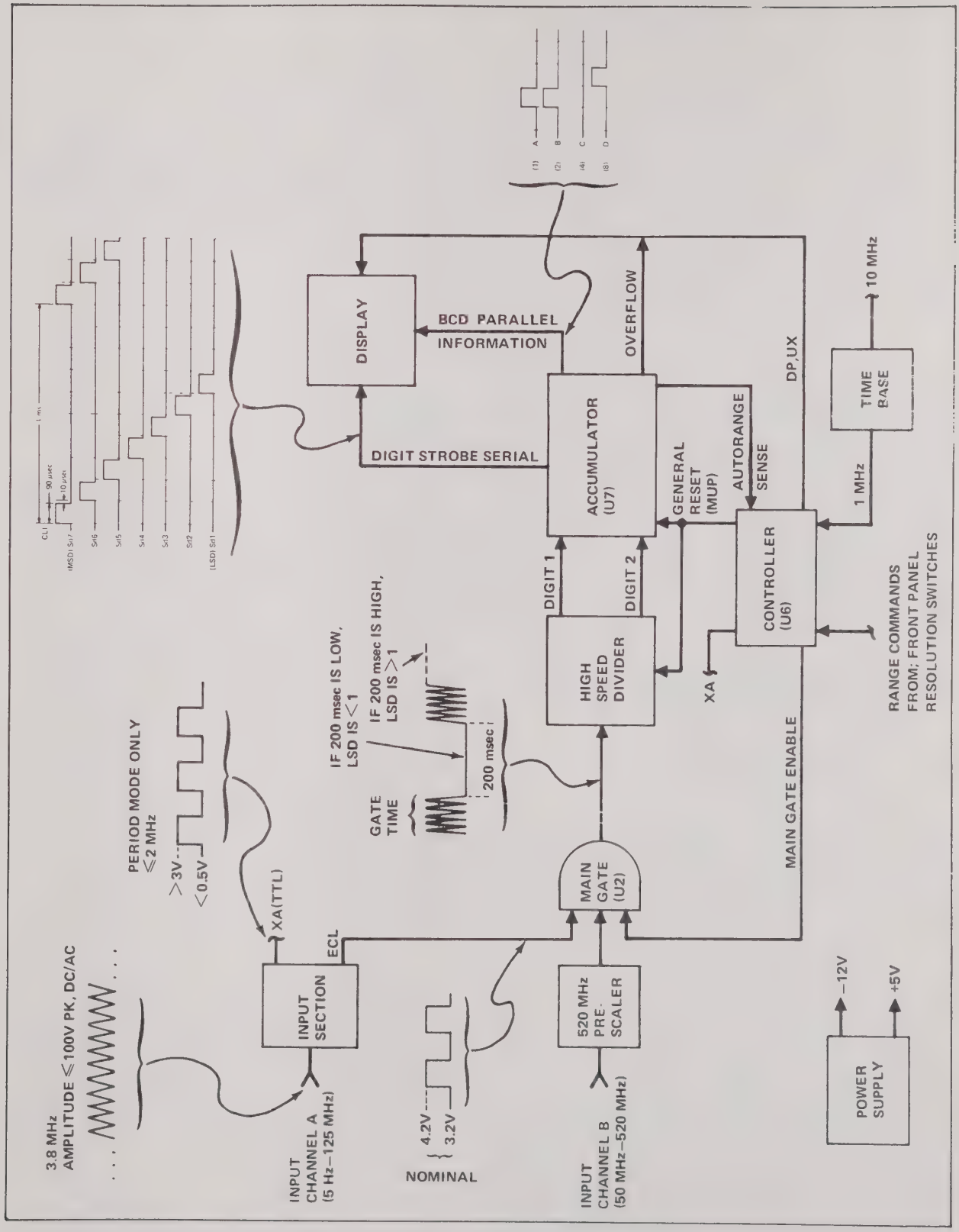


Figure 3-1. 1910A/1911A Overall Block Diagram

3-11. The controller is capable of performing numerous logic steps, see Figure 3-2, the first of which is start (step--1). Step-1 will be initiated whenever power is first applied to the counter, or if a new range, mode, or the reset switch has been actuated. Step-1 will initialize the counter to accept a new measurement. Step-2 is skipped as only odd numbered steps are used to order events. Step-3, the next event in the controllers logic enables the decade counters contained within the accumulator (U7) to count the frequency of the unknown signal.

3-12. Step-5 enables the autorange circuit. In this step the controller decides whether or not the range is adequate for optimum resolution. If the most significant digit (MSD) is less than one the optimum range has not been achieved and the controller will increase the gate time by a factor of 10. The controller will cycle through this until the MSD is one or greater, or until the longest gate time allowed has been reached. If a range has been manually selected then the resolution of the display (gate time) will be determined by the selected range, not the value of the MSD.

3-13. When in the autoranging mode, the controller provides a hysteresis circuit which prevents a shift in range when the frequency of the input signal changes by up to 20%. To activate the circuit the MSD must first be equal to one which sets the hysteresis flip-flop (HFF) high. The hysteresis then introduced by the controller will tend to hold the present range until the second significant digit (2SD) falls below 8.

3-14. Step-7 is called memory update (MUP). This step enables the controller to shift the count obtained in step-3 to the display. Step-9 is a wait period of 200ms which limits the controller to a maximum of five readings per second.

3-15 The controller logic will continue to cycle from step-3 through step-9 once every 200 ms plus the selected gate time. The controller will only revert to step-1 when the instrument is first turned on or if a new function, range or the reset switch is actuated.

3-16. Frequency Mode 1911A

3-17. The frequency mode of operation for the 1911A is identical to the 1910A's while using the channel A input. When channel B is selected the input must be applied to the channel B input where it is divided by a factor of 2 in the prescaler, refer to Figure 3-3. The decrease in frequency is necessary because the high speed decade counters have a maximum toggle speed of approximately 150 MHz. The rest of the frequency mode sequence is identical to that of the 1910A.

3-18. Period Mode

3-19. The period of an unknown signal is measured by counting a reference frequency during a specified number of input periods. The 1910A and 1911A models obtain their period measurement by applying the unknown input to the range control, using that input to derive the gate time, then counting the 10 MHz signal supplied by the time base. Figure 3-4 illustrates the configuration of the 1910A and 1911A in the period mode. Selection of the range control will directly determine the resolution of the period measurement. The longer the gate time, the more periods averaged, and hence better resolution.

3-20. Totalize Mode

3-21. The totalize mode is used to count the total number of events as they happen. This is achieved by bypassing the range and controller functions (see Figure 3-5) and continuously enabling the main gate. The totalize mode will count up to 9999999 at which time the overflow indicator will light, the display will reset to zero and resume counting The overflow indicator is the only annunciator used in totalize mode and the decimal point is not displayed. A new count may be manually initiated by depressing the reset button located on the front panel.

3-22. Self Check Mode

3-23. The self check mode is an internal verification system that uses the 10 MHz signal from the time base as an input. When in the self check mode manual selection of each range will verify the operation of all sections of the counter except the input sections and the time base accuracy. See Table 3-1 for correct display reading and Figure 3-6 for the simplified block diagram.

Table 3-1. Display Readout in Self Check Mode

MODE	DISPLAY	ANNUNCIATOR
Auto	10000.00	kHz
100 Hz	10.0000	kHz
10 Hz	10000.00	kHz
1 Hz	0000.000	Overflow kHz
0.1 Hz	000.0000	Overflow kHz
Reset	888.8888	kHz

3-24. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION

3-25. The Functional Block Diagram Description of the multicounter may be broken down into three basic sections: input, time base and display. The input section will explain the conditions of channel A and channel B (1911A only) input signals. It will also include the operation of the main gate. The second section will treat all other circuits which condition the input signal. These are: time base, decimal logic, range and autoranging logic. The last section, display, will explain how the conditioned input is displayed for visual reading.

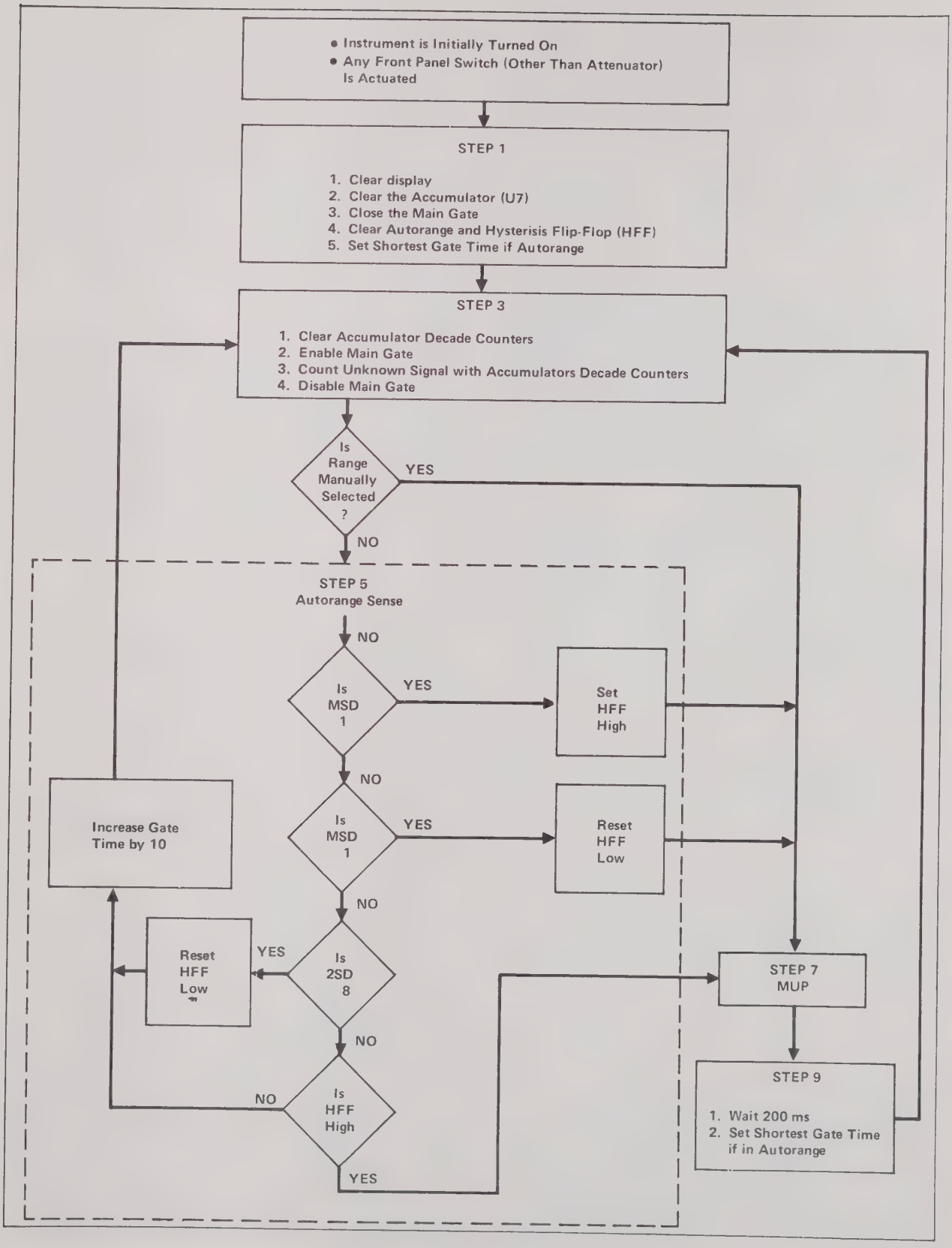


Figure 3-2. Controller Logic

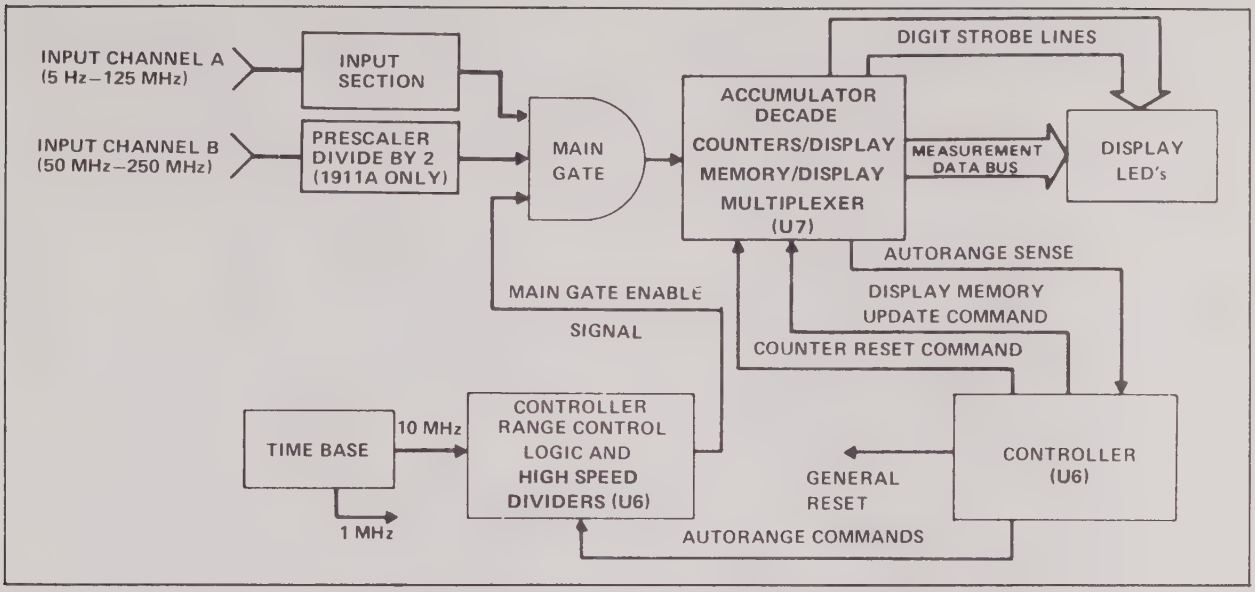


Figure 3-3. Frequency Mode

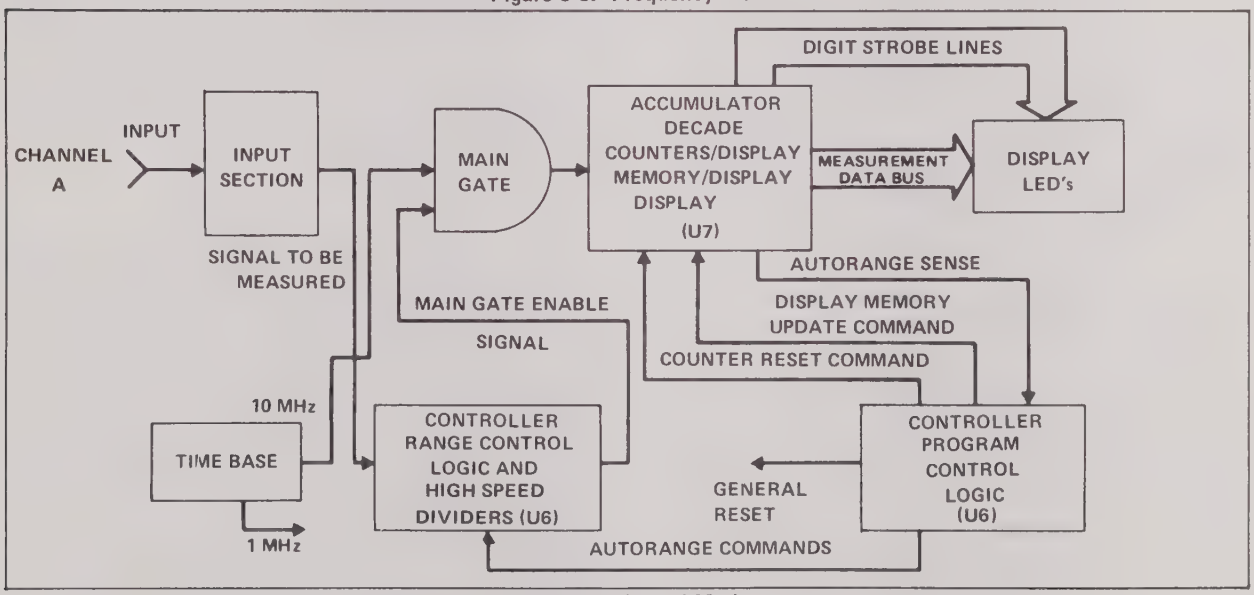


Figure 3-4. Period Mode

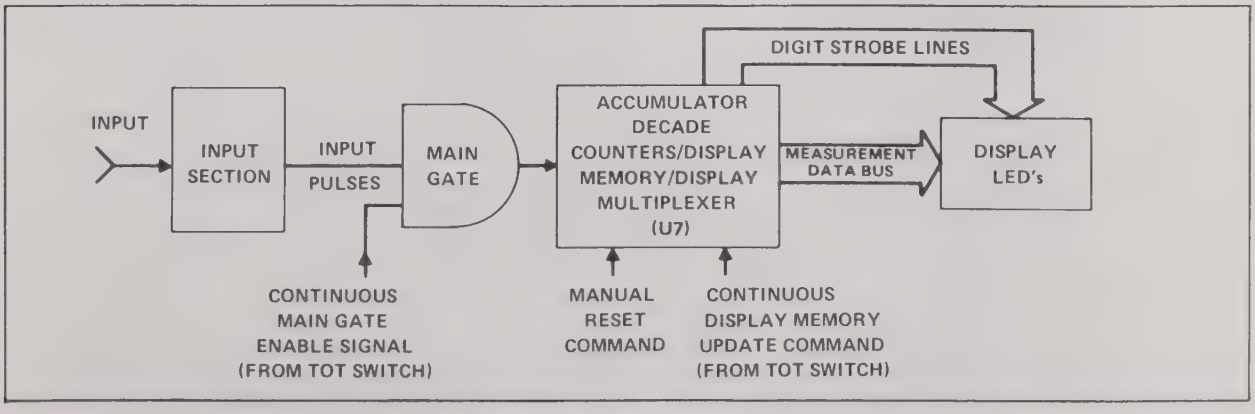


Figure 3-5. Totalize Mode

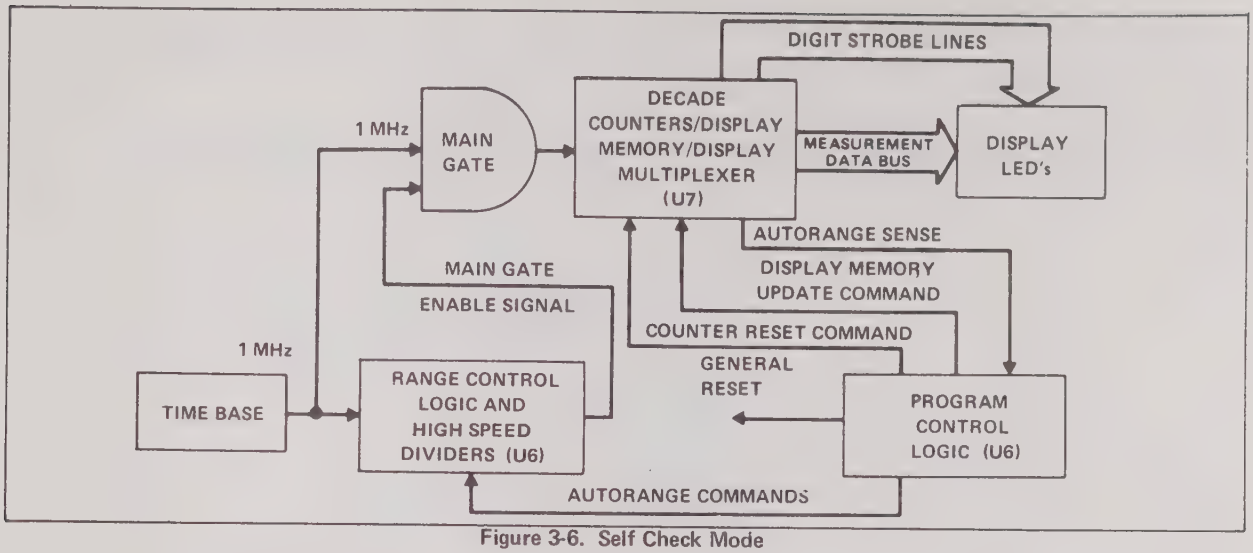


Figure 3-6. Self Check Mode

3-26. Input Section, Channel A

3-27. An input signal from the BNC connector (see Figure 3-7) is coupled through C1 to buffer amplifier, Q1. The signal is then applied to the custom IC U1, which includes in part a broadband amplifier, schmitt trigger, and output amplifiers. Attenuator switch S13, when depressed, decreases the gain to attenuate the signal and allow only one tenth of the amplitude of the input to pass. The first section of U1, the broadband amplifier provides gain over the wide range of input frequencies. The second section is a schmitt trigger used to square the output to obtain fast clean transitions. The third section, the output amplifiers, translate the input signal to the standard ECL and TTL levels.

3-28. Input Section Channel B (1911A Only)

3-29. For channel B inputs (Figure 3-8) the signal is amplified and fed to a high speed dual flip-flop where it is divided by 2 to bring it within the range of the high speed dividers. The prescaler also contains a level detector which blocks the prescalers operation when the input levels drop below a preset value. The manual selection of the B channel simultaneously inputs a prescaler code to the controller, U6. This code will cause the controller to double the gate time to compensate for the reduction of the input frequency by the prescaler.

3-30. Main Gate High Speed Dividers

3-31. At step-3 in the controllers logic a gate pulse is generated (GATE) and applied to the J and K inputs of the main gate (U2), See Section 8. The input signal is applied to the clock input of the main gate. The ECL output of U2 is translated to a TTL signal by Q4, Q5 and Q6 and applied to the clock input of the next high speed divider (U3B and U4A). The output of the first divider is applied to U7 on four BCD lines, A, B, C, and D. The D output is also applied to the next divider (U8). The rest of the dividers are contained in the display memory and multiplexer (U7), discussed later in this section.

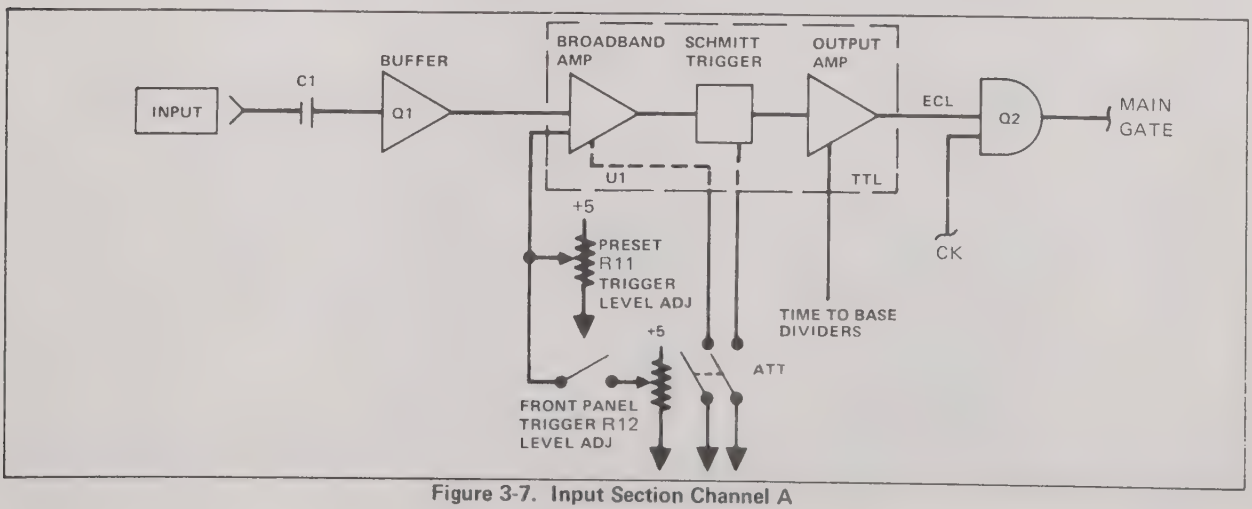


Figure 3-7. Input Section Channel A

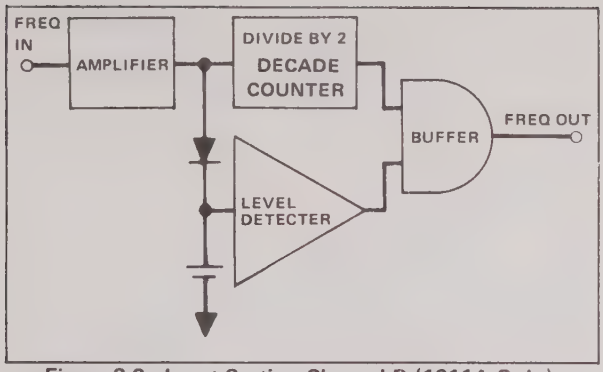


Figure 3-8. Input Section Channel B (1911A Only)

3-32. Time Base

3-33. The time base consists of a 10 MHz crystal (Y1), counter (U9). A schematic for this circuit can be found in Section 8. The time base is configured as a colpitts oscillator whose frequency is controlled by the crystal Y1. Buffer amplifier, Q7, drives the NOR gate, U5 which provides further buffering. The decade counter divides the 10 MHz output frequency to obtain the 1 MHz output from the decade counters is applied to the high speed dividers of the range control. In the period and self check modes the 10 MHz output from the time base is applied to the main gate.

3-34. Decimal Point Logic

3-35. This multi-counter uses a scheme to position the decimal which is synchronous with the appropriate digit strobe. An encoded input generated by the selection of a range (see Table 3-2 Range Encoding) will enable one of six possible AND gates contained within U6. A decimal positioning strobe (DP) will then be produced by U6 simultaneously with one of the six digit strobes (see Section 8) which will light the appropriate decimal. If autoranging has been selected the encoded range data input to the AND gates within U6 will change as the value of the signal being measured changes. Effectively, this allows the decimal position to shift and compensate for the change in range. The annunciators; kHz/usec, and MHz/msec, are lit by the same scheme used to position the decimal.

3-36. Range Control Logic (Frequency A Mode)

3-37. Selection of a range may be determined manually by one of the front panel range switches, or automatically by selecting the autorange mode. If the range is manually selected a range command (see Table 3-2) will be applied to U6. A division ratio of the 1MHz input (U6 pin 12) will be determined by the decade counters contained within U6 (See Section 8.) This division of the 1 MHz signal will effectively set the gate time by controlling the clocking of the main gate, with the GATE signal. The same scheme is used when the autorange mode is selected; however, in this case the range code is not a set output. The range code in autorange mode will change causing the division of the 1 MHz signal to change, which in turn will enable the gate time to increase or decrease depending upon the value of the signal being measured.

Table 3-2. Range Encoding (Frequency)

INPUT TO RANGE SWITCH ENCODING a) FREQUENCY A MODE					
Input to U6 Pin			Gate Time	Decimal Location Output	Annunciated Units Output
22	23	24			
0	1	0	10 msec*	D5	MHz
1	1	0	0.1 sec*	D3	KHz
0	0	1	1.0 sec*	D4	KHz
1	0	1	10 sec	D5	KHz
1	1	1	Autorange	■	■

**Obtainable gate times in autorange mode.*
■Not a fixed value.

3-38. Range Control Logic (Frequency B Mode 1911A Only)

3-39. The 1911A uses the same manual and autorange logic as the 1910A; however, because of prescaler is used to divide the channel B frequency by two, it is necessary to double the gate time. The increase in gate time is accomplished by dividing the 1 MHz input by 2.

3-40. Range Control Logic (Period Mode)

3-41. The range control logic for the period mode is the same as that of the frequency mode, except that the 1 MHz clock input is replaced with the channel A input (XA), See Section 8. XA signal is then divided by the decade counters within U6, the division ratio is again determined by the range selection. (See Table 3-3.) The divided XA signal is then applied to the main gate and used as the enable signal to allow the counting of the 10 MHz time base output.

Table 3-3. Range Encoding (Period)

INPUT TO RANGE SWITCH ENCODING (PERIOD MODE)						
Input to U6 Pin			Gate Time	Period	Decimal Location Output	Annunciated Units Output
22	23	24				
0	0	0	■	10^0	D5	msec
1	0	0	■	10^1	D6	msec
0	1	0	■	10^2	D4	μsec
1	1	0	■	10^3	D5	μsec
0*	0*	1*	■	10^4	D6	μsec
1	1	1	■			

* *Obtainable only in the period mode of operation when using the autorange resolution.*
■ *Not a fixed value.*

3-42. Autorange Logic

3-43. When the autorange mode is selected the range input lines (U6 pins 22, 23, and 24) are replaced by circuits internal to U6 which will select the gate time that will provide the highest resolution possible (See Table 3-3 for the autorange encoding in the period mode, and Table 3-2 for the autorange encoding in the Frequency A mode.)

3-44. Display Memory And Multiplexer

3-45. When step-7 is reached, (in the controller's logic) the controller generates a memory update signal (MUP) (see Figure 3-9). At this time the contents of the decade counters are shifted into a series of four bit latches. A 10 kHz oscillator and a 10 stage ring counter inside U7 generate strobe signals used by the display multiplexer. The gates are sequentially enabled by the strobe signals to apply the contents of the four bit latches onto the common display data bus. Information on this data bus is decoded by a seven segment decoder for applicaton to the display.

3-46. Display

3-47. The display section (see Figure 3-10) consists of seven, seven segment LED's each containing its own decimal point. The appropriate LED is enabled simultaneously with the enabling of a gate in the display multiplexer. This allows the digit information to be applied via a common data bus to all LED's. However, only the LED that is enabled by the gate within the display multiplexer will accept the data and light.

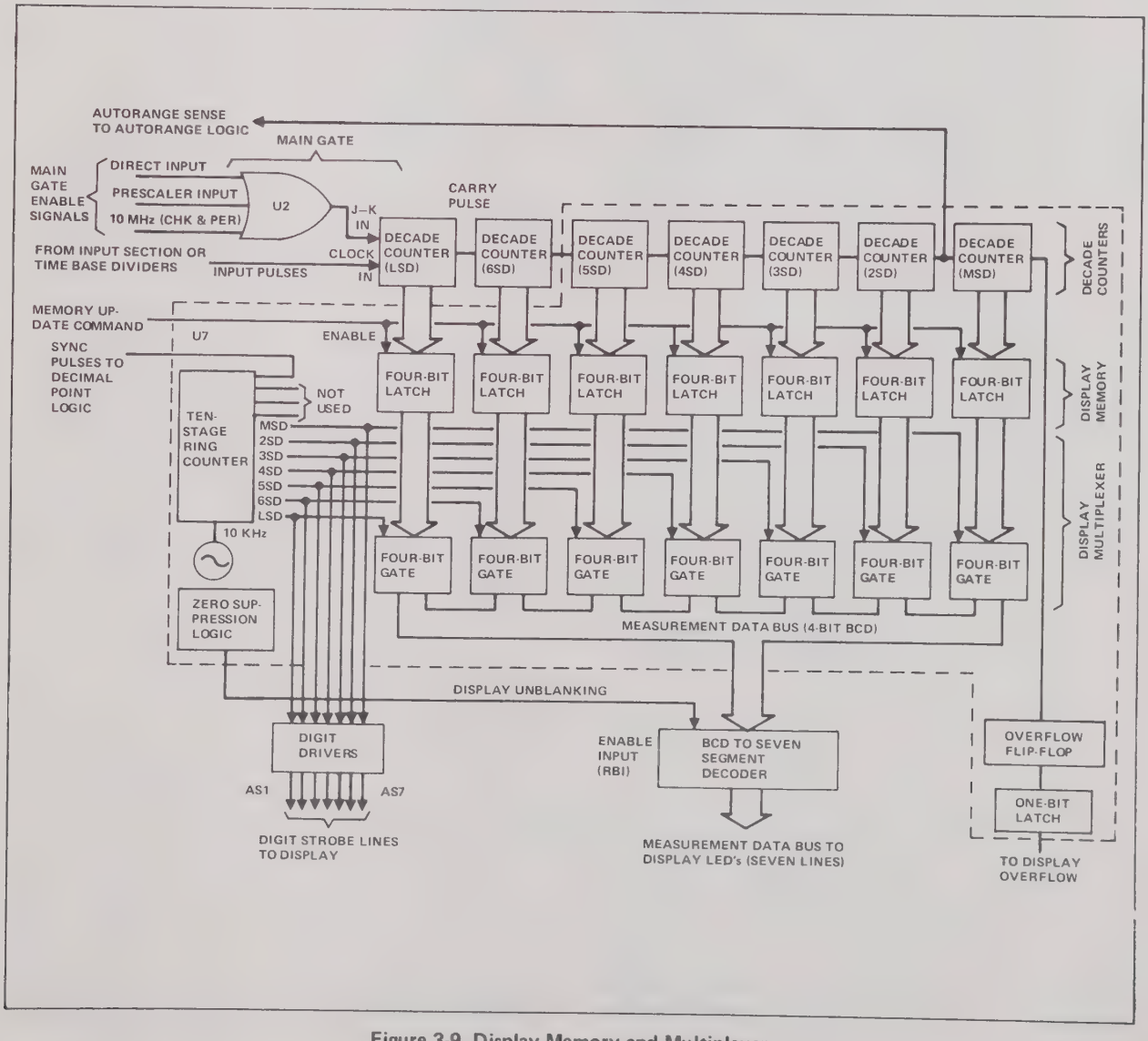


Figure 3-9. Display Memory and Multiplexer

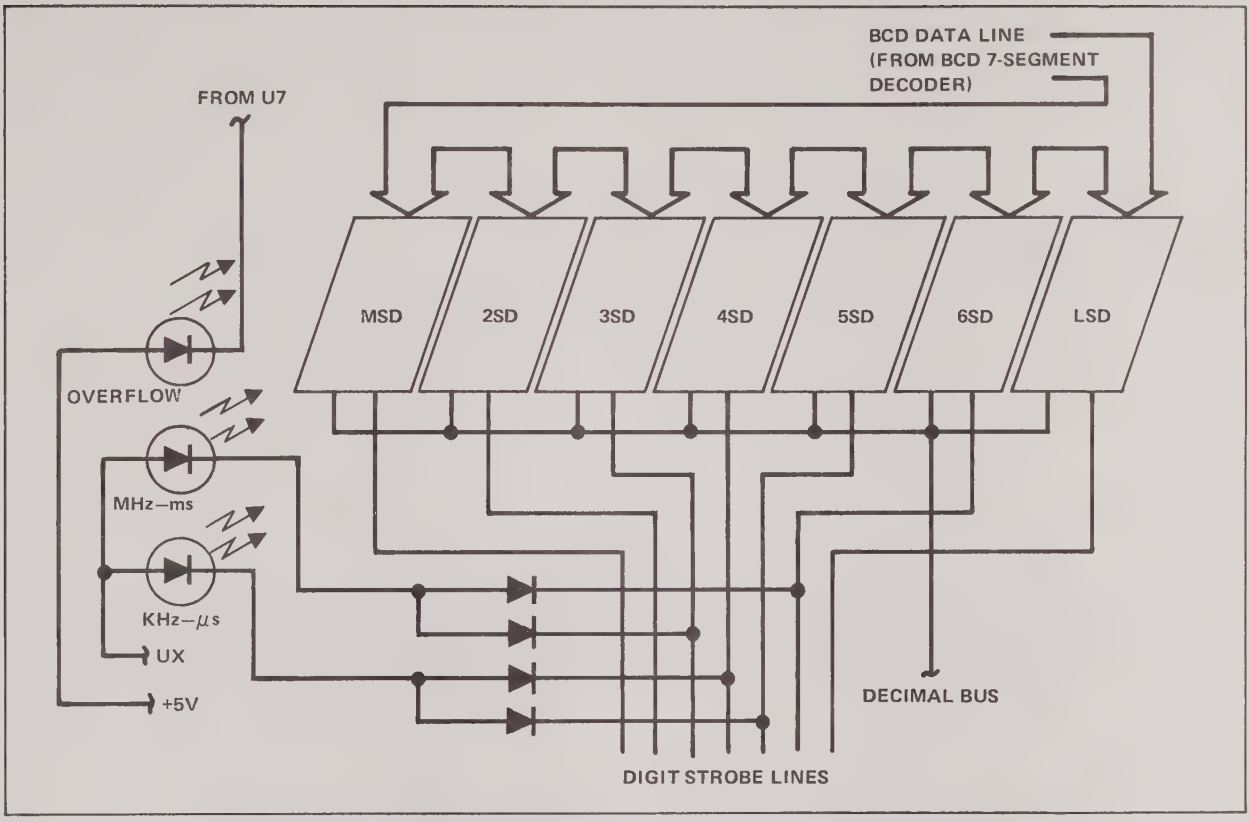


Figure 3-10. Display

Section 4
Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section contains information concerning preventive maintenance for the Model 1910A and 1911A multi-counters. Both instruments are designed to meet or exceed the rated specifications under normal operation for a period of one year. Equipment for performing specification test and calibrating adjustments are listed in Table 4-1. If this equipment is not available, other equipment having equivalent specifications may be used.

4-3. SERVICE MAINTENANCE

4-4. Should your instrument need repair, send it to the nearest authorized service center. A list of these authorized service centers is located in Section 7.

4-5. GENERAL MAINTENANCE

4-6. Access

4-7. Use the following procedure to gain access to the interior of the multi-counter.

1. With the power switch in the off position (out), disconnect the line cord, external clock input, and DOU connection (if used).

2. Remove the phillips screw on rear panel, directly below the line connector.

3. Hold rear of instrument case firmly and pull front panel straight out.

Table 4-1. Required Test Equipment

EQUIPMENT NOMENCLATURE	MINIMUM SPECIFICATIONS	RECOMMENDED EQUIPMENT
Quartz oscillator frequency standard with 20 MHz output.	1×10^{-8} ppm stability	HP 105A/B
Low frequency oscillator	5 Hz to 10 MHz 5 mV to 500 mV	Fluke 6010
High Frequency oscillator	10 MHz to 250 MHz 5 mV to 500 mV	Wave Tek 2001
RF Millivoltmeter with 50Ω terminator, + high impedance terminator	5 mV sensitivity 10 kHz to 250 MHz	Boonton 92B
Multimeter	Greater than 200 mV sensitivity	Fluke 8000A
Oscilloscope	Greater than 100 mV/div.	Tek 465

4. Top and bottom shield may be removed by six # 2-56 screws.

5. All replaceable parts are now visible and may easily be maintenanced.

6. Reassemble in the opposite order.

4-8. Cleaning

CAUTION!

If any solvent is used, such as freon, it should be kept clear of switches, potentiometers, transformer windings and plastics, since it removes lubrication and breaks down winding insulation.

4-9. Periodically clean the multi-counter to remove accumulated dust, grease, and other contaminants using the following procedure:

1. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or soft cloth dampened with a mild solution of detergent and water.

2. If cleaning of the interior is necessary use clean, dry air at low pressure (20 psi). If contaminants remain individual pcbs can be cleaned using warm water, however, any items likely to be affected by the water (batteries, etc.) should be removed first. Excess water should be blown free with the clean dry air followed by a thorough drying. Do not use drying temperatures in excess of 59°C.

4-10. Fuse Replacement.

4-11. The input power fuse, F1 is located on the rear panel (See Figure 2-1). If replacement is necessary, use an AGC 1/8 amp fast blow for 100 and 115V, a 1/16 amp fast blow for 230 volt input, and an 1/2 amp slow blow for battery operated units.

4-12. PERFORMANCE TEST

4-13. The performance test is used to compare the sensitivity of the instrument with the list of specifications in Table 1-3. These tests are suitable for incoming inspection, periodic maintenance and to verify overall operation. If the instrument fails to meet any of these checks, repair or calibration is required.

4-14. Initial Procedure Check

4-15. The following conditions must be met before proceding to the performance test.

1. All external inputs must be made via a shielded cable with a compatible BNC connector.

2. External clock switch must be in internal position.

3. Trigger level must be in the preset position.

4. Attenuator switch should be in the out position.

5. Unit to meet the following checks (See Table 4-2).

4-16. Sensitivity Check (Channel A)

NOTE

The Wavetek generator is an analog frequency selectable device whose output is directly proportional to the accuracy of the adjustments made by the operator.

1. Connect the low frequency generator set to 10 Hz at 15 mV to the channel A input. If using the 6010A or 6011A signal generators terminate their outputs in 50Ω.

Table 4-2. Initial Procedure Check

FUNCTION	RESOLUTION	DISPLAY	ANNUNCIATERS
FREQ CH A/CH B	100 Hz	0.0000	MHz
FREQ CH A/CH B	10 Hz	0.00	kHz
FREQ CH A/CH B	1 Hz	0.000	kHz
FREQ CH A/CH B	0.1 Hz	0.0000	kHz
PER	0.1 Hz	0.0000	μs
PER	1 Hz	0.000	μs
PER	10 Hz	0.00000	ms
PER	100 Hz	0.0000	ms
CHK	100 Hz	10.0000	MHz
CHK	10 Hz	10000.00	kHz
CHK	1 Hz	0000.000	kHz Overflow
CHK	0.1 Hz	000.0000	kHz Overflow
CHK	AUTO	10000.00	kHz
CHK & RESET	AUTO	88888.88	kHz
TOT	AUTO	0	

2. Energize the counter and select the frequency channel A function and auto resolution.

3. Confirm that the display reads 0.010 kHz ±1 digit.

4. Disconnect the low frequency generator and connect a high frequency source terminated in a 50Ω at a T-connector on the A channel input. Also connect a RF millivolt meter to the T-connector.

5. Refer to Table 4-3 and set the generator for 150 mV at about 10 MHz to obtain a reference reading. Now lower the generator level until the counter's display changes. Verify that the level at which the display changes is below 15 mV.

Table 4-3. High Frequency Sensitivity Check (Channel A)

GENERATOR SETTING		DISPLAY READING ± GENERATOR STABILITY
FREQUENCY	LEVEL RMS	
10 MHz	15 mV	10000.00 kHz
50 MHz	15 mV	50000.00 kHz
100 MHz	15 mV	100.0000 MHz
125 MHz	25 mV	125.0000 MHz

6. Repeat Step 5 for each frequency listed in Table 4-3. Note that at 125 MHz the level must be below 25 mV before the display changes.

4-17. Sensitivity Check Channel B (1911A only)

1. Connect the high frequency generator and an R.F. millivoltmeter to the channel B input via a high impedance T-connector.

2. Set the generator to about 50 MHz at 150 mV.

3. Energize the counter and depress the frequency B function switch; select 100 Hz resolution.

4. Make a note of the display reading & reduce the level of the generator until the display goes to zero. The level at which the drop out occurs should be less than 15 mV.

5. Repeat Step 4 at 100 MHz and 175 MHz.

6. Repeat Step 4 at 200 MHz and 250 MHz noting the dropout level is less than 30 mV.

4-18. CALIBRATION

4-19. The multi-counter should be calibrated once a year or whenever a sensitivity or accuracy check indicates that the instrument does not meet the specifications. Calibration requires no more than the adjustment of the trigger level, time base oscillator frequency, and the drop out level for the 1911A channel B (threshold adjustment).

4-20. Trigger/Hysteresis Level Adjustment (Channel A)

4-21. The trigger level adjustment should be performed whenever repairs have been made to the input section of the counter. Perform the trigger/hysteresis level adjustment as follows:

1. Remove the instrument from its case.

2. Connect the high frequency generator and an RF millivoltmeter via a T-connector terminated into 50Ω to the channel-A input, energize counter.

3. Set the front panel trigger level control to the preset position.

4. Set the generator to 75 mV output level at about 100 MHz, note the display reading as a reference.

5. Set the hysteresis trimpot (R20) to its maximum clockwise position.

6. Reduce the input level until the display becomes unstable and then try to adjust R11 (internal trigger level, see Figure 4-1) for the reference reading as noted in step-4.

7. Repeat step-6 until no additional sensitivity is possible.

8. Repeat sensitivity check channel-A. If counter does not meet this check turn the hysteresis trimpot (R20) counter-clockwise until all display limits as listed in Table 4-3 are met.

4-22. Threshold Adjustment (Channel B 1911A)

1. Remove counter from case.

2. Set function switch to frequency channel B and resolution to 100 Hz.

3. Connect a high frequency generator to a T-connector to the B channel input. Also connect an RF millivoltmeter to the T-connector.

4. Set the generator to about 250 MHz at 25 mV.

5. Set threshold trimpot (R310) on prescaler PCB to maximum counter clockwise position (see Figure 4-1).

6. Advance the trimpot (R310) clockwise until the display goes to zero. Then slowly advance the trim-

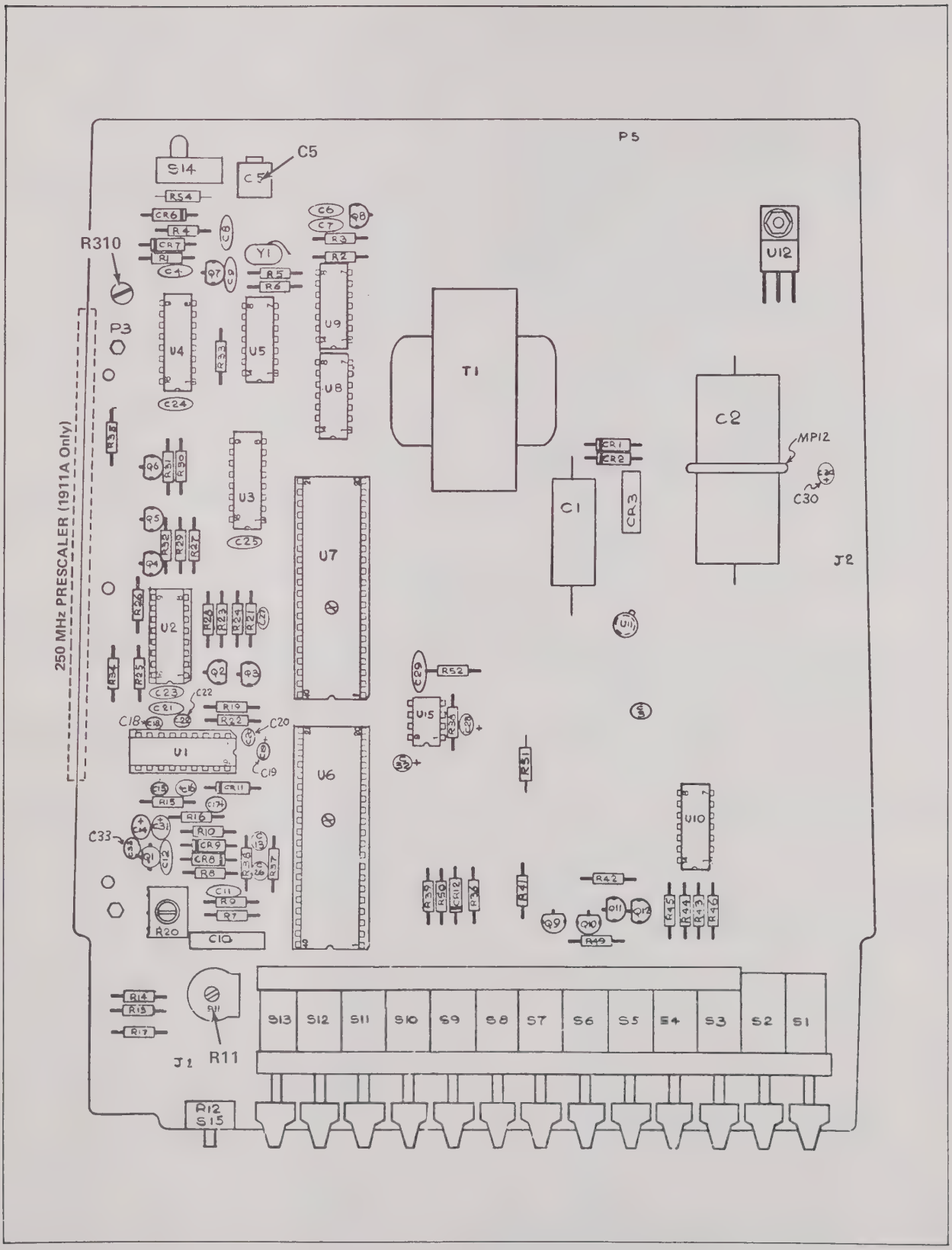


Figure 4-1. Main PCB (Top View)

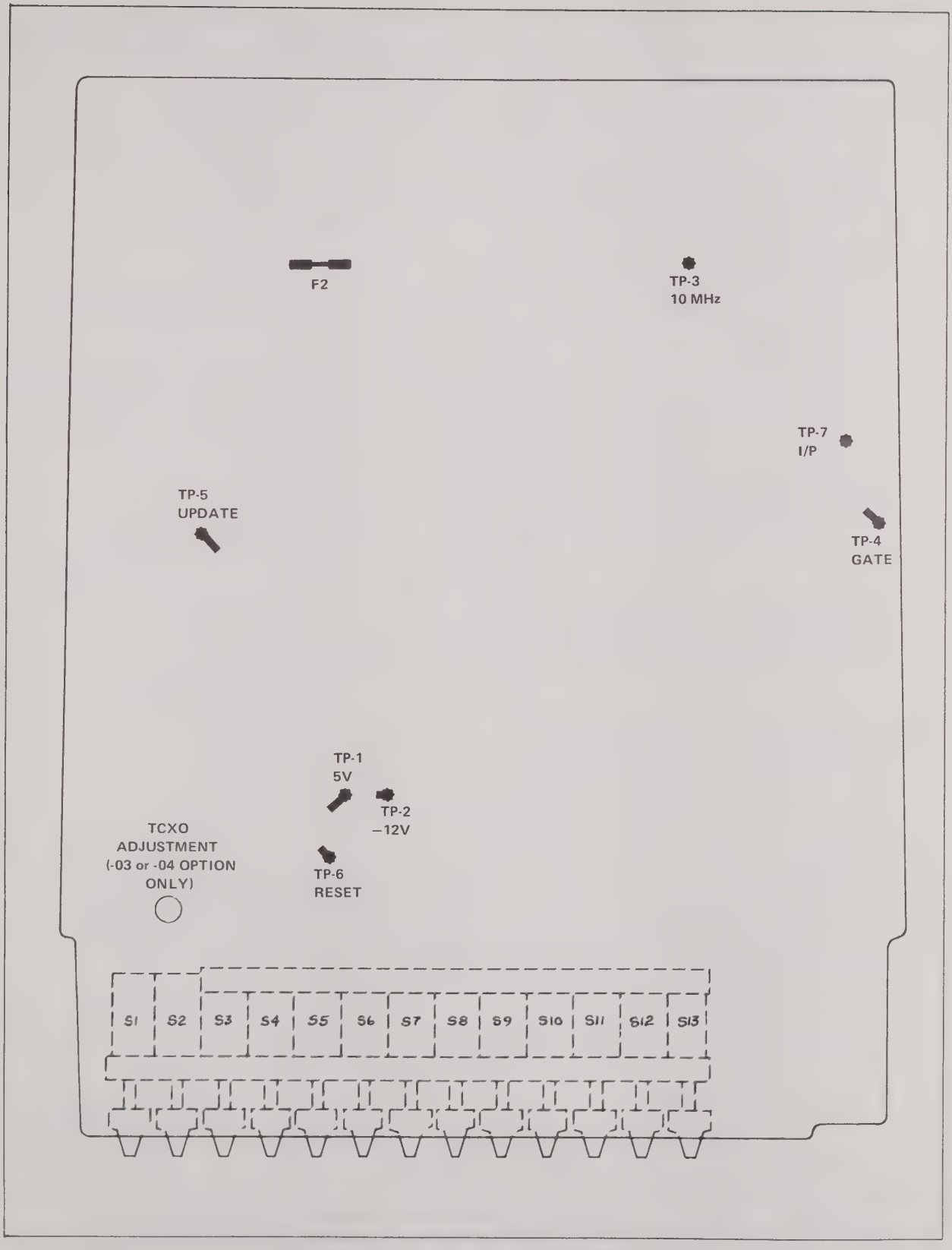


Figure 4-2. Main PCB (BOTTOM VIEW)

pot counter clockwise until the display reads correctly.

7. Reduce the input level and verify that the reading remains good to an input level less than 30 mV.

8. Change the signal generator to 50 MHz and about 100 mV. Reduce the input level and verify that the display reading remains good to below 15 mV. If not readjust R310.

9. The correct adjustment for R310 is for a clean drop out of readings when the level is about 10 mV for frequencys to 175 MHz and about 25 mV at higher than 175 MHz.

4-23. Time Base Adjustment (Standard Unit)

1. Allow the counter to operate for at least 30 minutes in the case to stabilize the internal temperature.

2. Energize the counter and select the FREQ function and 1 Hz resolution.

3. Select a 10 MHz output on the quartz oscillator and connect the 10 MHz signal to the counter input.

4. While observing the counter display, adjust the time base oscillator control (C5 located on the rear panel (see Figure 4-1) to obtain a reading of 000000 ±5 digits.

4-24. Time Base Calibration (Option –03 and –04)

1. Allow the counter to operate for at least 30 minutes in the case to stabilize the internal temperature.

2. Remove the instrument from the case and immediately reconnect line cord.

3. Select the channel A function at .1 Hz resolution.

4. Connect the 10 MHz reference frequency to the channel A input.

5. Using a nonconductive screwdriver adjust the TCXO through the main PCB (see Figure 4-2) to obtain a reading of overflow 000.0000 Hz ±3 digits for the –03 and –04 Options.

4-25. TROUBLESHOOTING

4-26. The following discussion shall be used to isolate and correct any problems still existing after completion of the sensitivity and calibration procedures, for explanation of the symbols used see Figure 4-3. The entirety of the troubleshooting procedure for the instrument is contained within two sections. The first section (Figure 4-4) details a self-check operation that covers all sections of the counter other than the amplifier U1. The second section (Figure 4-5) completes the troubleshooting procedure by systematically checking U1.

NOTE

Typical ECL, TTL levels are as follows:

ECL logic 1 = 4.1V
ECL logic 0 = 3.2V
TTL logic 1 = 2.5V
TTL logic 0 = 0.6V

NOTE!

Test points are clearly marked on the bottom of the main PCB with a number and a star, see Figure 4-2.

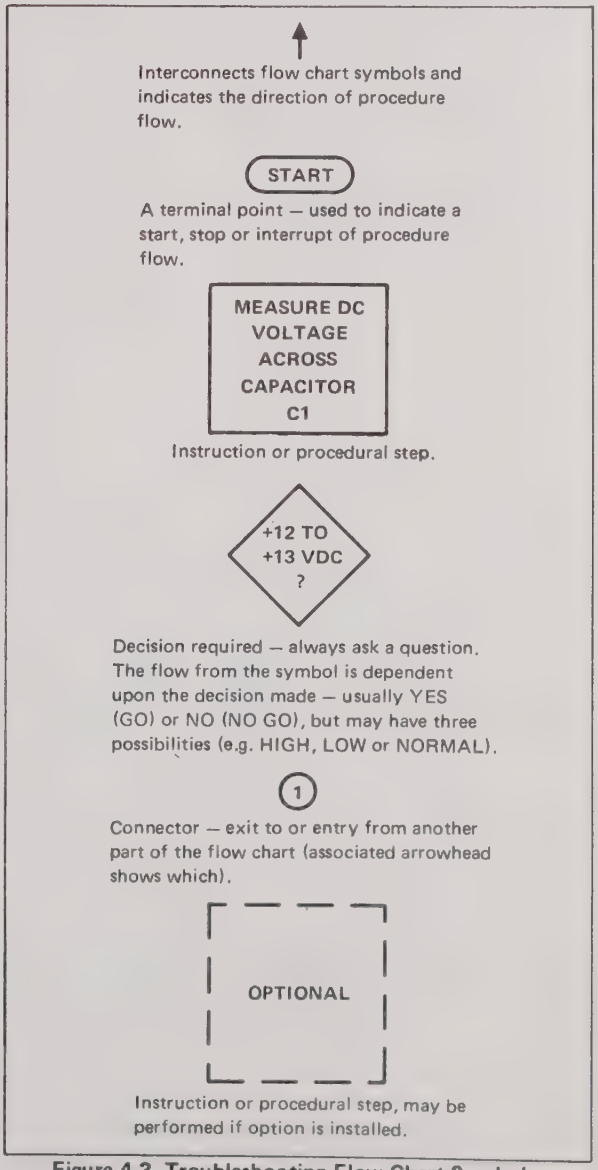

Interconnects flow chart symbols and indicates the direction of procedure flow.
START
A terminal point – used to indicate a start, stop or interrupt of procedure flow.
MEASURE DC VOLTAGE ACROSS CAPACITOR C1
Instruction or procedural step.
+12 TO +13 VDC ?
Decision required – always ask a question. The flow from the symbol is dependent upon the decision made – usually YES (GO) or NO (NO GO), but may have three possibilities (e.g. HIGH, LOW or NORMAL).
1
Connector – exit to or entry from another part of the flow chart (associated arrowhead shows which).
OPTIONAL
Instruction or procedural step, may be performed if option is installed.

Figure 4-3. Troubleshooting Flow Chart Symbols

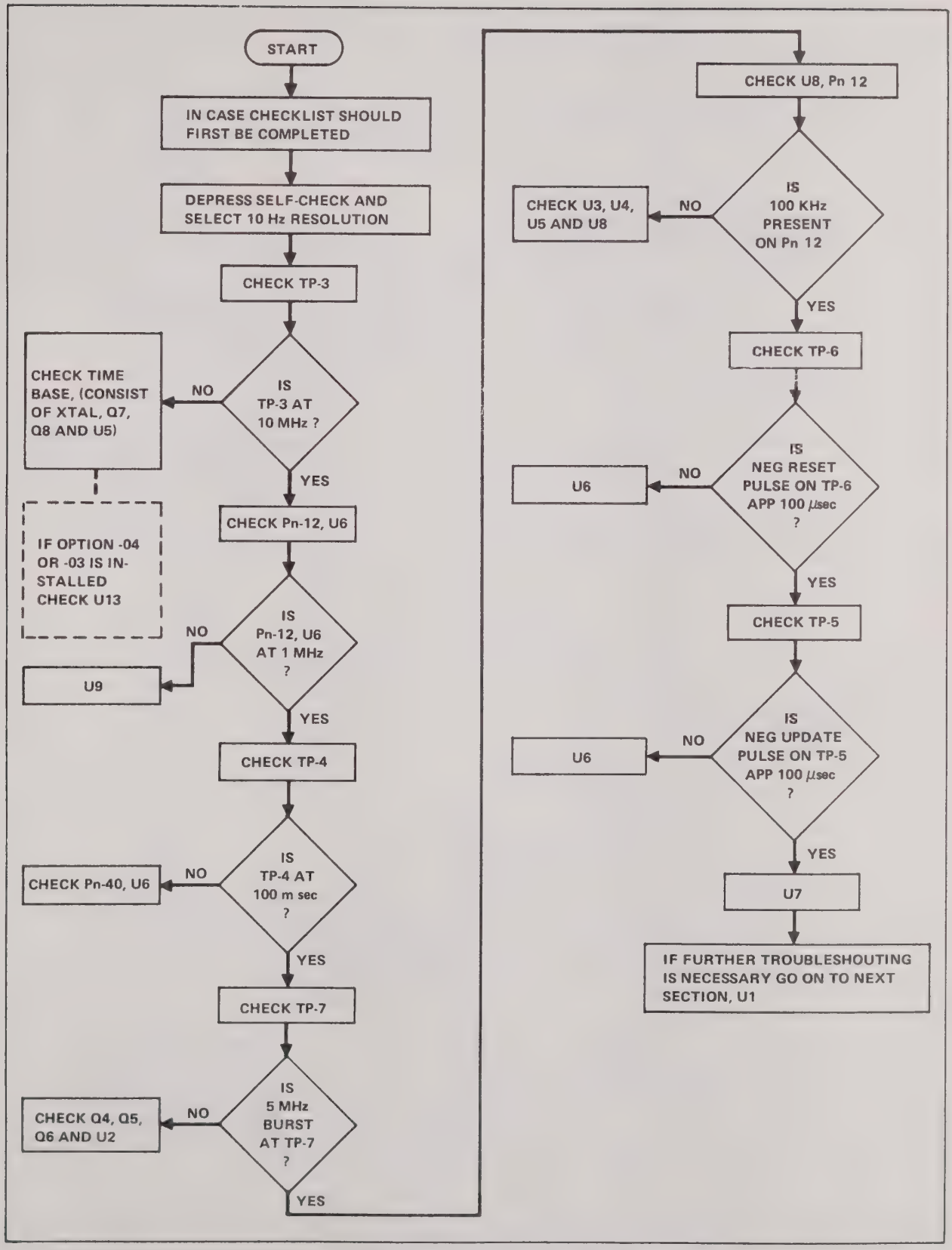


Figure 4-4. Troubleshooting Flow Chart Self Check

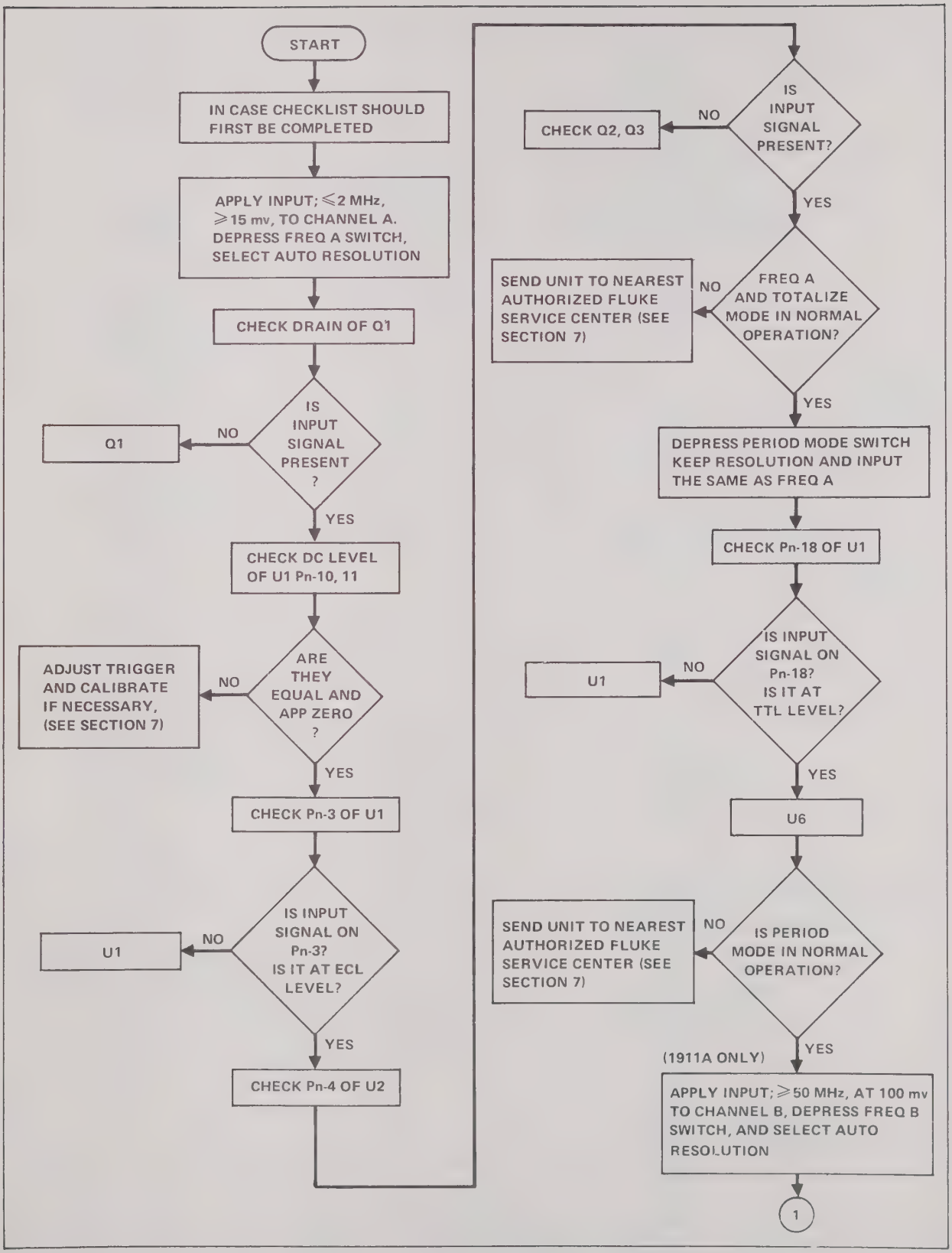

START
IN CASE CHECKLIST SHOULD FIRST BE COMPLETED
APPLY INPUT; ≤2 MHz, ≥15 mv, TO CHANNEL A. DEPRESS FREQ A SWITCH, SELECT AUTO RESOLUTION
CHECK DRAIN OF Q1
IS INPUT SIGNAL PRESENT ?
NO
Q1
YES
CHECK DC LEVEL OF U1 Pn-10, 11
ARE THEY EQUAL AND APP ZERO ?
NO
ADJUST TRIGGER AND CALIBRATE IF NECESSARY, (SEE SECTION 7)
YES
CHECK Pn-3 OF U1
IS INPUT SIGNAL ON Pn-3? IS IT AT ECL LEVEL?
NO
U1
YES
CHECK Pn-4 OF U2
IS INPUT SIGNAL PRESENT?
NO
CHECK Q2, Q3
YES
FREQ A AND TOTALIZE MODE IN NORMAL OPERATION?
NO
SEND UNIT TO NEAREST AUTHORIZED FLUKE SERVICE CENTER (SEE SECTION 7)
YES
DEPRESS PERIOD MODE SWITCH KEEP RESOLUTION AND INPUT THE SAME AS FREQ A
CHECK Pn-18 OF U1
IS INPUT SIGNAL ON Pn-18? IS IT AT TTL LEVEL?
NO
U1
YES
U6
IS PERIOD MODE IN NORMAL OPERATION?
NO
SEND UNIT TO NEAREST AUTHORIZED FLUKE SERVICE CENTER (SEE SECTION 7)
YES
(1911A ONLY)
APPLY INPUT; ≥50 MHz, AT 100 mv TO CHANNEL B, DEPRESS FREQ B SWITCH, AND SELECT AUTO RESOLUTION
1

Figure 4-5. Troubleshooting Flow Chart U1

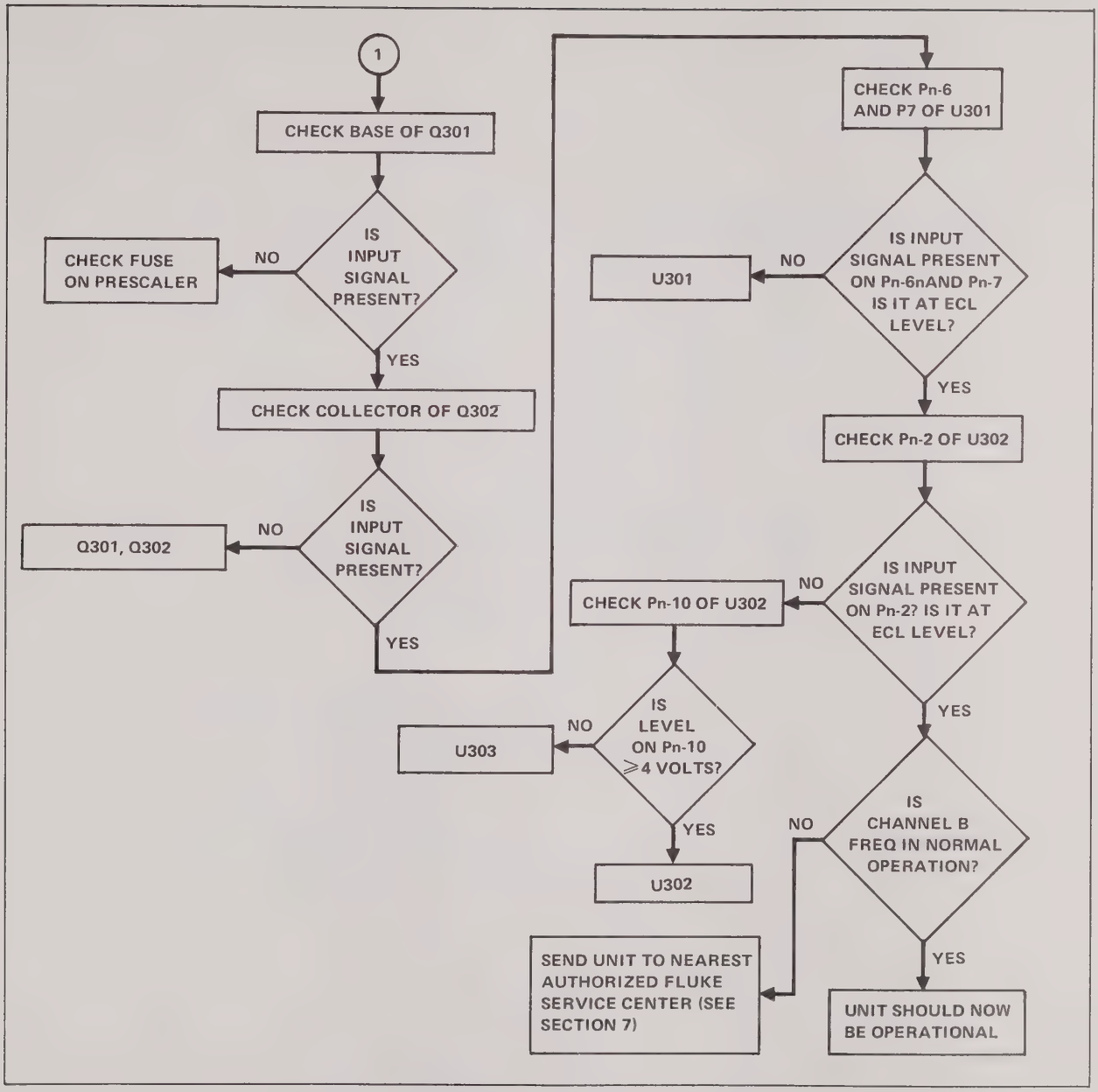


Figure 4-5. Troubleshooting Flow Chart U1 (Concluded)

Section 5
List of Replaceable Parts

NOTE
Unless otherwise specified all parts, drawings, and general information contained in this section pertains to both the Model 1910A and 1911A multi-counters.

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5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphanumerically by assembly. Electrical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation or Item Number.

2. Description of each part.

3. Fluke Stock Number.

4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

5. Manufacturer's Part Number or Type.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommending number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or form the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure the prompt and effecient handling of your order, include the following information:

1. Quantity.

2. FLUKE Stock Number.

3. Description.

4. Reference Designation or Item Number

5. Printed Circuit Board Part Number.

6. Instrument Model and Serial Number.

CAUTION!

⊗ Indicates devices are subject to damage by static discharge.

Table 5-1. 1910A/1911A Final Assembly, Line Power

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	⊗ 1910A/1911A FINAL ASSY, LINE POWER FIGURE 5-1	ORDER	MODEL	1910A OR 1911A			
A1	⊗MAIN PCB ASSEMBLY (10A/11A-4001)	ORDER	FOR	APPLICABLE SOURCE	1		
F1	FUSE (ORDER FOR APPLICABLE SOURCE)	NOT	SHOWN				
	FUSE, 1/8 AMP (100V & 115V SOURCE)	166488	71400	MDL1-8	1	5	
	FUSE, 1/16 AMP S.B. (230V SOURCE)	163030	71400	MDL1-16	1	5	
H1	SCREW, PHP, 2-56 X 1/4	149534	89536	149534	6		
H2	SCREW, PHP, 6-32 X 3/8	152165	89536	152165	1		
H3	SCREW, THD, FORMING, 6-20 X 3/8	288266	89536	288266	2		
H4	WASHER, FLAT	340505	89536	340505	2		
H5	WASHER, LOCK, INTRNL TOOTH #2	110676	89536	110676	2		
MP1	BASIC CASE	458331	89536	458331	1		
MP2	FOOT PAD	338632	89536	338632	2		
MP3	HANDLE, MOLDED	330092	89536	330092	1		
MP4	SHEILD, BOTTOM	458869	89536	458869	1		
MP5	SHEILD, TOP	459248	89536	459248	1		
MP6	SPECIFICATION DECAL	429316	89536	429316	1		
MP7	KNOB DECAL	347401	89536	347401	2		
MP8(F1)	FUSE INSERT (FOR ALL SOURCES) NOT SHOWN	460238	89536	460238	1		
U6	⊗IC, P-MOS (INSTALLED IN TEST)	460063	89536	460063	1		
U7	⊗IC, MOS (INSTALLED IN TEST)	473215	89536	473215	1		
W1W3W7	JUMPER WIRES,FOR 115V SOURCE (NOT SHOWN)	451278	89536	451278	AR		
W2,W7	JUMPER WIRES,FOR 230V SOURCE (NOT SHOWN)	465237	89536	465237	AR		
W3W1W7	JUMPER WIRES,FOR 100V SOURCE (NOT SHOWN)	451310	89536	451310	AR		
W10	LINE CORD W/INTERNAL CONN (NOT SHOWN)	343723	89536	343723	1		

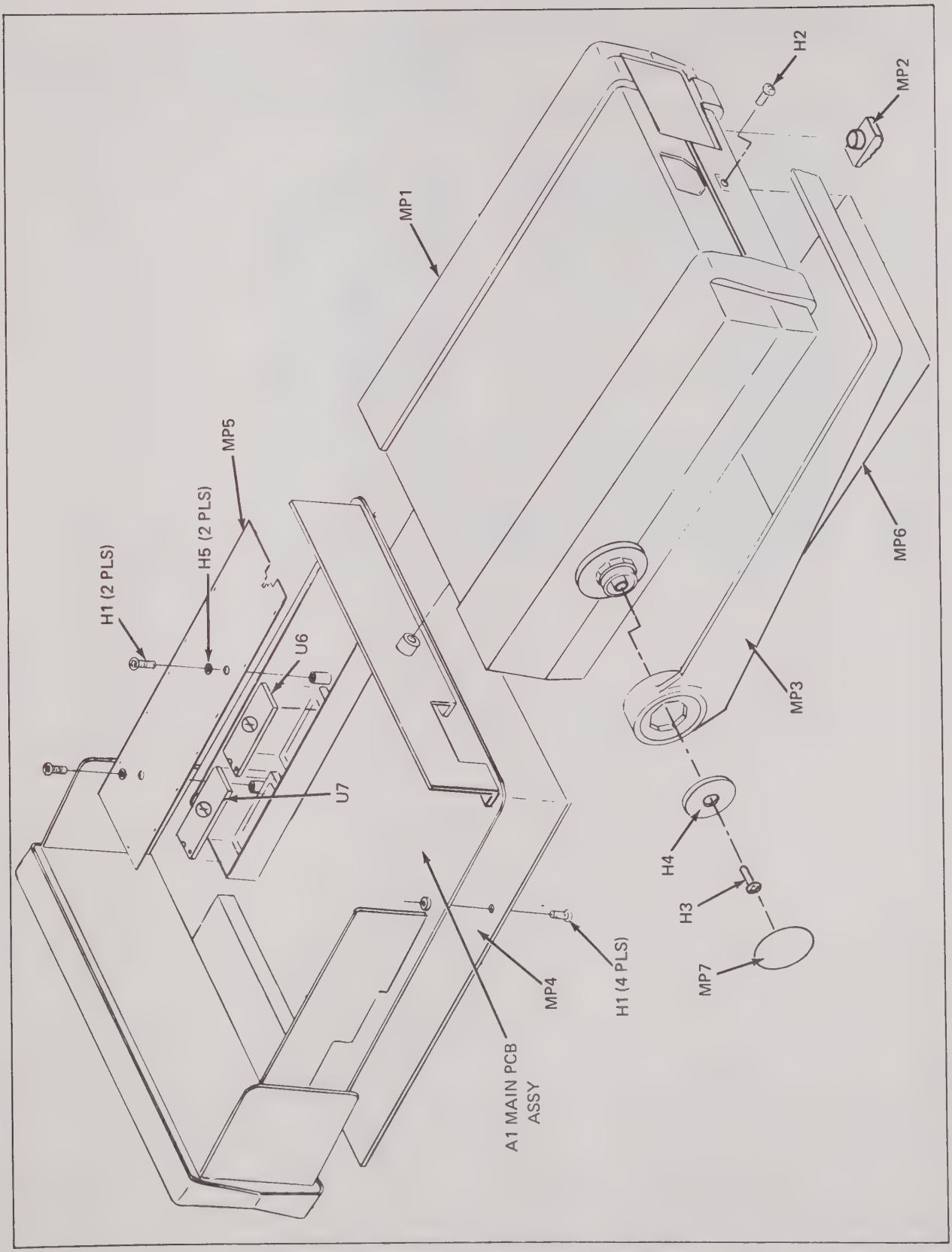

Figure 5-1. 1910A/1911A Final Assembly, Line Power

Table 5-2. A1 Main PCB Assembly, Line Power

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	⊘MAIN PCB ASSY(10A/11A-4001)FIG. 5-2	ORDER	MODEL	1910A OR 1911A	1		
A1A2	DISPLAY PCB ASSY (1910A-4020T)	ORDER	MODEL	1910A OR 1911A	1		
A1A3	250MHZ PRESCLAER(1910A-4003T) 1911A ONLY	443341	89536	443341	1		
C1	CAP,ELECT,680UF,-10/+50%,25V	218172	73445	ET681X-025A02	1	1	
C2	CAP,ELECT,5000UF,-10/+100%,15V	379370	25088	B41010-5000/15	1	1	
C3	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	7		
C4	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	6		
C5	CAP,VAR,7 - 25PF,350V	229948	72982	538-006B-7-25	1	1	
C6	CAP,CER,22PF,+/-20%,10KV	369157	72982	831-000-C0G0-220	4		
C7	CAP,CER,47PF,+/-20%,1000V	369132	56289	C020B-1024470J	1		
C8	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C9	CAP,CER,0.001UF +/-10%,1KV	368621	71590	DD-102	1		
C10	CAP,POLYSTYRNE FILM,0.1UF,+/-10%,400V	447573	73445	C280MAF/A100K	1		
C11	CCAP,CER,100PF,+/-10%,1KV	105593	71590	DD101	1		
C12	CAP,CER,22PF,+/-20%,10KV	369157	72982	831-000-C0G0-220	REF		
C13	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C14	CAP,TA,22UF,+/-20%,15V	423012	56289	196D226X-0015KA1	2		
C15	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	5		
C16	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C17	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C18	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	REF		
C19	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C20	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	REF		
C21	CAP,CER,22PF,+/-20%,10KV	369157	72982	831-000-C0G0-220	REF		
C22	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	REF		
C23	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C24	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C25	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C26	CAP,TA,1UF,+/-20%,15V	161919	56289	196D105X-0035JA1	1		
C27	CAP,CER,0.01UF,+/-20%,100V	407361	72982	812-A100-W5R-103M	1		
C28	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C29	CAP,CER,0.0012UF,+/-10%,500V	106732	71590	CF122	1		
C30	CAP,TA,22UF,+/-20%,15V	423012	56289	196D226X-0015KA1	REF		
C31	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C32	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101-F103M	REF		
C33	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	REF		
CR1	DIODE,SI,RECTIFIER	343491	04713	1N4002	2	1	
CR2	DIODE,SI,RECTIFIER	343491	04713	1N4002	REF		
CR3	RECTIFIER BRIDGE	296509	09423	FB200	1	1	
CR6	DIODE,HI-SPEED SWITCHING	203323	07910	1N4448	3	1	
CR7	DIODE,HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR8	DIODE,LO-CAP	381806	07910	1N3062	2	1	
CR9	DIODE,LO-CAP	381806	07910	1N3062	REF		
CR11	DIODE,ZENER,400MW,+/-5%,6.8V	260695	07910	1N754A	1	1	
CR12	DIODE,HI-SPEED SWITCHING	203323	07910	1N4448	REF		
H1	LUG,SOLDER	151431	79963	329	2		
H2	LUG,SOLDER	441972	79963	761	2		
H3	NUT,HEX 4-40,STEEL NICKEL PLATED	110635	73734	8003NP	2		
H4	SCREW,PHP,4-40X1/4	129890	73734	19021	1		
H5	WASHER,INT LOCK,#4	110403	73734	99402	3		
H6	NUT,HEX,1/4-32,BRASS NICKEL PLATED	110601	73734	1/4-32 NEF2B	1		
H7	SCREW,PHP, 3/16 X 6-32, CAD PLATE	381087	89536	381087	2		
J1	CONN,RECEPTACLE,BNC	152033	95712	30355-1	3		
J2	CONN,RECEPTACLE,BNC,ASSEMBLY	152033	95712	30355-1	REF		
J3	CONN, RECPTACLE, BNC (1911A ONLY)	152033	95712	30355-1	REF		
MP1	CABLE CLAMP (NOT SHOWN)	172080	06383	SST-1M	1		
MP2	DECAL,FRONT PANEL (1910A ONLY)	429324	89536	429324	1		
MP3	DECAL FRONT PANEL (1911A ONLY)	453969	89536	453969	1		
MP4	DECAL,XFRM WARNING (NOT SHOWN)	386250	89536	386250	1		
MP5	KNOB,POINTER	448803	89536	448803	1		
MP6	LENS,FRONT	456582	89536	456582	1		
MP7	PANEL,REAR	443291	89536	443291	1		
MP8	PANEL,FRONT	443283	89536	443283	1		

Table 5-2. A1 Main PCB Assembly, Line Power (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
MP9	SHEILD,WALL	459230	89536	459230	1		
MP10	TERMINAL GUIDES	375840	89536	375840	1		
MP12	CABLE TIE	331157	06383	PLT2M			
MP13	RETANIER	352484	77969	9109-E	2		
MP14	TERMINAL PINS	376574	00779	3-87022-1	3		
MP15	FUSE HOLDER,ASSEMBLY	460329	89536	460329	1		
MP16	TRANSIPAD (NOT SHOWN)	152207	07047	10123-DAP	1		
Q1	XSTR, FET, JUNCTION, N-CHANNEL	288324	89536	288324	1	1	
Q2	XSTR, FET, N-CHANNEL	404277	89536	404277	1	1	
Q3	XSTR, SI, PNP	195974	04713	2N3906	4	1	
Q4	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q5	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q6	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q7	XSTR, NPN	218396	04713	2N3904	5	1	
Q8	XSTR, FET, JUNCTION, N-CHANNEL	386094	89536	386094	1	1	
Q9	XSTR, NPN	218396	04713	2N3904	REF		
Q10	XSTR, NPN	218396	04713	2N3904	REF		
Q11	XSTR, NPN	218396	04713	2N3904	REF		
Q12	XSTR, NPN	218396	04713	2N3904	REF		
R1	RES, DEP CAR, 1K,+/-5%,1/4W	343426	80031	CR251-4-5P1KT	6		
R2	RES, DEP CAR, 1M, +/-5%, 1/4W	348987	80031	CR25-4-5P1MT	4		
R3	RES, DEP CAR, 2.7K,+/-5%,1/4W	386490	80031	CR251-4-5P2K7T	3		
R4	RES, DEP CAR, 180,+/-5%, 1/4W	441436	80031	CR251-4-5P180ET	2		
R5	RES, DEP CAR, 560, +/-5%, 1/4W	385948	80031	CR251-4-5P560ET	5		
R6	RES, DEP CAR, 10K, +/-5%, 1/4W	348839	80031	CR251-4-5P10KT	8		
R7	RES, DEP CAR, 1M, +/-5%, 1/4W	348987	80031	CR25-4-5P1MT	REF		
R8	RES,DEP CAR,150, +/-5%,1/4W	343442	80031	CR251-4-5P150ET	2		
R9	RES,DEP CAR,1M,+/-5%,1/4W	348987	80031	CR251-4-5P1MT	REF		
R10	RES, DEP CAR, 2.7K,+/-5%,1/4W	386490	80031	CR251-4-5P2K7T	REF		
R11	RES,VAR,CAR,COMP,10K,+/-20%,0.2W	369553	54869	PT10V-10K	1	1	
R12	RES/SWITCH,POTENTIOMETER,10K	443044	89536	443044	1	1	
R13	RES,DEP CAR,22K,+/-5%,1/4W	348870	80031	CR251-45P-22KT	2	1	
R14	RES, DEP CAR,150K,+/-5%,1/4W	348938	80031	CR251-4-5P150KT	1		
R15	RES,DEP CAR, 1.5K,+/-5%,1/4W	343418	80031	CR251-4-5P1K5T	2		
R16	RES,DEP CAR, 1.5K,+/-5%,1/4W	343418	80031	CR251-4-5P1K5T	REF		
R17	RES,DEP CAR,22K,+/-5%,1/4W	348870	80031	CR251-45P-22KT	REF		
R19	RES, DEP CAR, 560, +/-5%, 1/4W	385948	80031	CR251-4-5P560ET	REF		
R20	RES,VAR,CERMET,10K +/-5%,1/4W	309674	89536	309974	1		
R21	RES, DEP CAR, 10K, +/-5%, 1/4W	348839	80031	CR251-4-5P10KT	REF		
R22	RES,DEP CAR,100K,+/-5%,1/4W	348920	80031	CR251-4-5P100KT	3		
R23	RES, DEP CAR, 1K,+/-5%,1/4W	343426	80031	CR251-4-5P1KT	REF		
R24	RES,DEP CAR,1.2K,+/-5%,1/4W	441378	80031	CR251-4-5P1K2T	1		
R25	RES,DEP CAR, 270,+/-5%,1/4W	348789	80031	CR251-4-5P270ET	1		
R26	RES,DEP CAR, 220,+/-5%,1/4W	342626	80031	CR251-4-5P220ET	1		
R27	RES,DEP CAR, 33,+/-5%,1/4W	414524	80031	CR251-4-5P33ET	1		
R28	RES, DEP CAR, 560, +/-5%, 1/4W	385948	80031	CR251-4-5P560ET	REF		
R29	RES, DEP CAR, 1K,+/-5%,1/4W	343426	80031	CR251-4-5P1KT	REF		
R30	RES, DEP CAR, 2.7K,+/-5%,1/4W	386490	80031	CR251-4-5P2K7T	REF		
R31	RES,DEP CAR,150, +/-5%,1/4W	343442	80031	CR251-4-5P150ET	REF		
R32	RES, DEP CAR, 1K,+/-5%,1/4W	343426	80031	CR251-4-5P1KT	REF		
R33	RES, DEP CAR, 560, +/-5%, 1/4W	385948	80031	CR251-4-5P560ET	REF		
R34	RES, DEP CAR, 1K,+/-5%,1/4W	343426	80031	CR251-4-5P1KT	REF		
R35	RES, DEP CAR, 10K, +/-5%, 1/4W	348839	80031	CR251-4-5P10KT	REF		
R36	RES,DEP CAR,100K,+/-5%,1/4W	348920	80031	CR251-4-5P100KT	REF		
R37	RES, DEP CAR, 1M, +/-5%, 1/4W	348987	80031	CR25-4-5P1MT	REF		
R38	RES, DEP CAR, 1K,+/-5%,1/4W	343426	80031	CR251-4-5P1KT	REF		
R39	RES, DEP CAR, 10K, +/-5%, 1/4W	348839	80031	CR251-4-5P10KT	REF		
R42	RES,DEP CAR, 27,+/-5%,1/4W	348763	80031	CR251-4-5P27ET	2		
R43	RES,DEP CAR, 27,+/-5%,1/4W	348763	80031	CR251-4-5P27ET	REF		
R44	RES,DEP CAR, 4.7K +/-5%,1/4W	348821	80031	CR251-4-5P4K7T	2		
R45	RES,DEP CAR, 4.7K +/-5%,1/4W	348821	80031	CR251-4-5P4K7T	REF		
R46	RES, DEP CAR, 560, +/-5%, 1/4W	385948	80031	CR251-4-5P560ET	REF		

Table 5-2. A1 Main PCB Assembly, Line Power (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R48	RES, DEP CAR, 180,+/-5%, 1/4W	441436	80031	CR251-4-5P180ET	REF		
R49	RES, DEP CAR, 10K, +/-5%, 1/4W	348839	80031	CR251-4-5P10KT	REF		
R51	RES,DEP CAR,100K,+/-5%,1/4W	348920	80031	CR251-4-5P100KT	REF		
R52	RES, DEP CAR, 10K, +/-5%, 1/4W	348839	80031	CR251-4-5P10KT	REF		
R54	RES,COMP,47 +/-5% 1/4W	147892	01121	CB4705	1		
S1	SWITCH,BUTTON,GREEN	445197	89536	445197	1		
S1 - S13	SWITCH ASSEMBLY	429589	89536	429589	1		
S2	SWITCH,BUTTON,BLUE	445205	89536	445205	1		
S3	SWITCH,BUTTON,DARK GREY	426759	89536	426759	6		
S4	SWITCH,BUTTON,DARK GREY	426759	89536	426759	REF		
S5	SWITCH,BUTTON,DARK GREY	426759	89536	426759	REF		
S6	SWITCH,BUTTON,DARK GREY	426759	89536	426759	REF		
S7	SWITCH,BUTTON,DARK GREY	426759	89536	426759	REF		
S8	SWTICH,BUTTON,LIGHT GREY	425900	89536	425900	5		
S9	SWTICH,BUTTON,LIGHT GREY	425900	89536	425900	REF		
S10	SWTICH,BUTTON,LIGHT GREY	425900	89536	425900	REF		
S11	SWTICH,BUTTON,LIGHT GREY	425900	89536	425900	REF		
S12	SWTICH,BUTTON,LIGHT GREY	425900	89536	425900	REF		
S13	SWITCH BUTTON,DARK GREY	426759	89536	426759	REF		
S14	SWITCH,SLIDE	354878	95146	MSS22504	1		
S15	SWITCH/POTENTIOMETER	SEE	R12				
T1	XFRM POWER	ORDER	FOR	APPLICABLE SOURCE			
	XFRM POWER,115/230V SOURCE	463794	89536	463794	1		
	XFRM POWER,100V SOURCE	463810	89536	463810	1		
U1	IC, WIDEBAND AMP	SEE	FINAL	ASSEMBLY			
U2	IC,DGTL,ECL,EDGE-TRIG JK FLIP-FLOP	402743	12040	F95029DC	1	1	
U3	IC,TTL,DUAL JK FLIP-FLOP (SCHOTTKY)	363440	01295	SN74S112N	2	1	
U5	IC,DGTL,QUAD,2-INPUT,POS NOR GATES	288845	01295	SN7402N	1	1	
U6	⊗SEE FINAL ASSEMBLY PARTS LIST						
U7	⊗SEE FINAL ASSEMBLY PARTS LIST						
U8	IC,TTL,50MHZ DECADE COUNTER	320754	01295	SN74196N	1	1	
U9	IC,DGTL,TTL,MSI,DECADE COUNTERS	402545	01295	SN74LS90N	1	1	
U10	IC,DGTL.MOS-TO-LED,HEX/DIGIT/DRIVER	429506	12040	DS75492N	1	1	
U11	IC,LINEAR,V/REGULATOR	429514	07623	79M12HC	1	1	
U12	IC,LINEAR,V/REGULATOR	355107	04713	MC7805CP	1	1	
U15	IC,LINEAR TIMER	402610	12040	LM555CN	1		
W1	CABLE ASSY(1911A ONLY)	450049	89536	450049	1		
XU1	SOCKET,IC,18-PIN	413229	91506	318-AG39D	1		
XU2	SOCKET,IC,16-PIN	276535	91506	316-AG39D	3		
XU3	SOCKET,IC,16-PIN	276535	91506	316-AG39D	REF		
XU4	SOCKET,IC,16-PIN	276535	91506	316-AG39D	REF		
XU6	SOCKET,IC,40-PIN	386060	09922	DILB40P-1	2		
XU7	SOCKET,IC,40-PIN	386060	09922	DILB40P-1	REF		
Y1	CRYSTAL,10MHZ	385732	89536	385732	1		

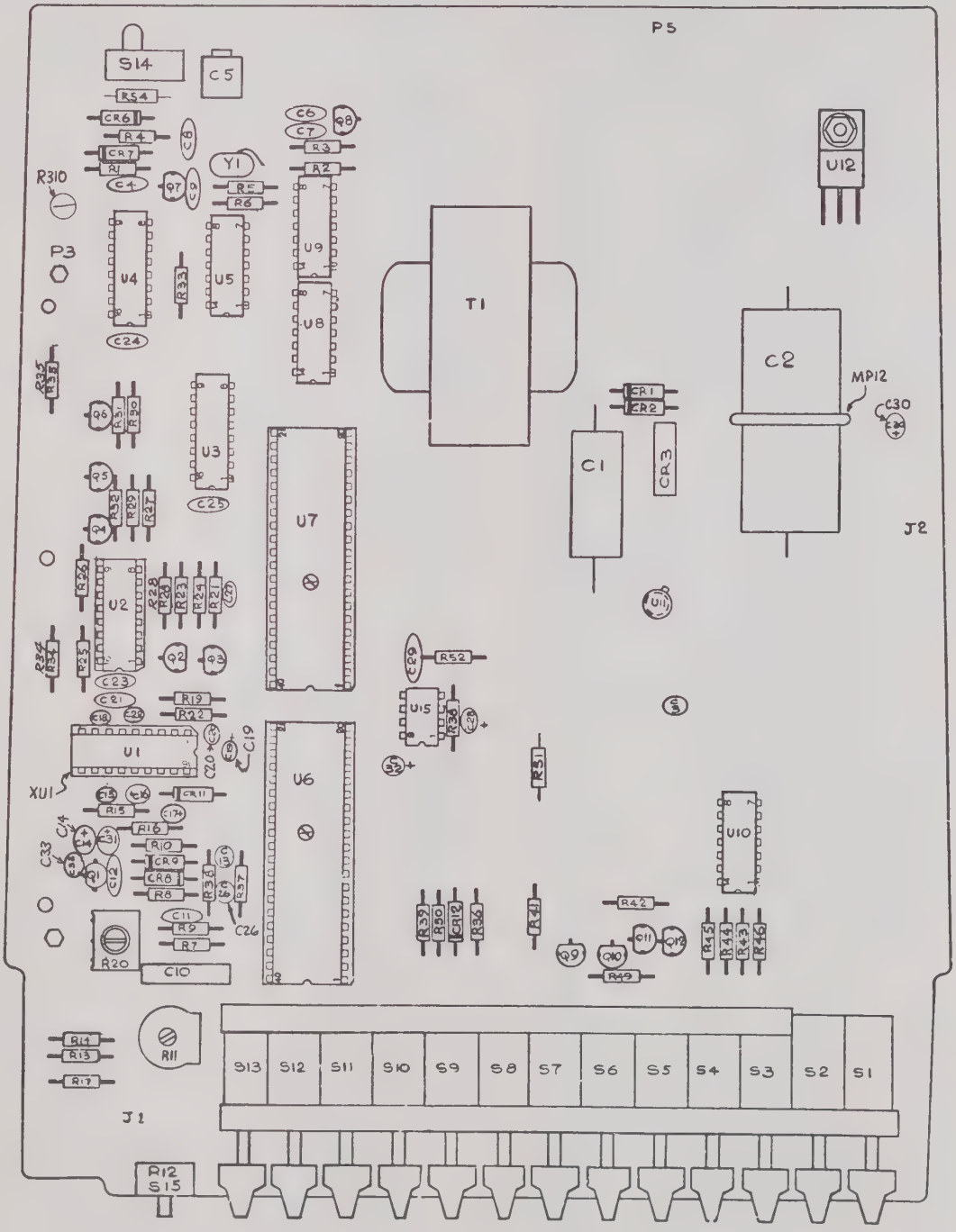

Figure 5-2. A1 Main PCB Assembly, Line Power (Sheet 1 of 2)

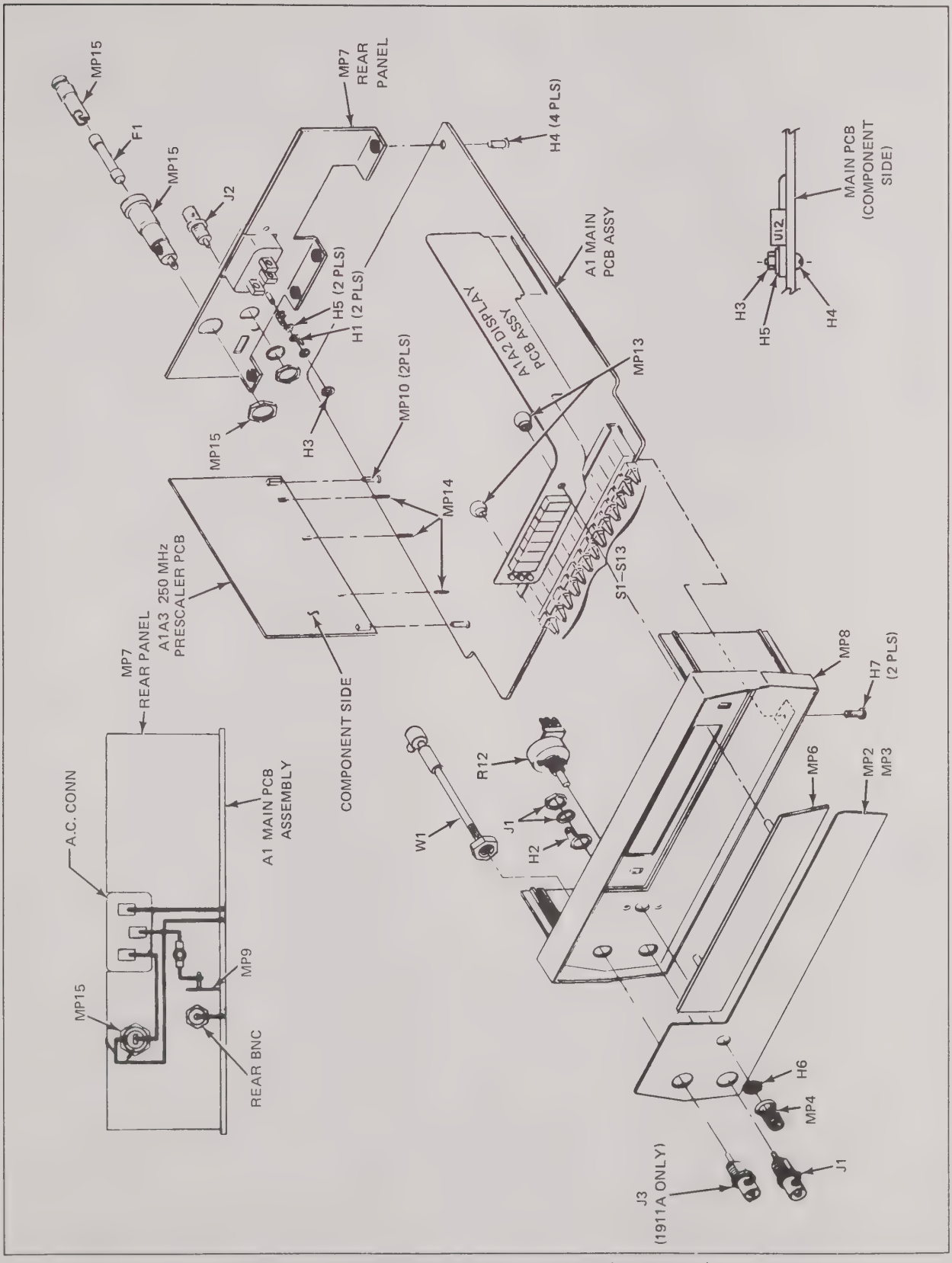

Figure 5-2. A1 Main PCB Assembly, Line Power (Sheet 2 of 2)

Table 5-3. A1A2 Display PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1A2	DISPLAY PCB ASSY (1910A-4020T) FIG 5-3	ORDER	MODEL	1910A OR 1911A	1		
CR201	DIODE, HI-SPEED SWITCHING	203323	07910	2N4448	4		
CR202	DIODE, HI-SPEED SWITCHING	203323	07910	2N4448	REF		
CR203	DIODE, HI-SPEED SWITCHING	203323	07910	2N4448	REF		
CR204	DIODE, HI-SPEED SWITCHING	203323	07910	2N4448	REF		
DS201	DIODE, LED, CLEAR	385898	28480	55082-4887	3		
DS202	DIODE, LED, CLEAR	385898	28480	55082-4887	REF		
DS203	DIODE, LED, CLEAR	385898	28480	55082-4887	REF		
U201	IC, DISPLAY LED	454249	28480	5082-7613	7	2	
U202	IC, DISPLAY LED	454249	28480	5082-7613	REF		
U203	IC, DISPLAY LED	454249	28480	5082-7613	REF		
U204	IC, DISPLAY LED	454249	28480	5082-7613	REF		
U205	IC, DISPLAY LED	454249	28480	5082-7613	REF		
U206	IC, DISPLAY LED	454249	28480	5082-7613	REF		
U207	IC, DISPLAY LED	454249	28480	5082-7613	REF		
U208	IC, MOS, DIGITAL	429506	12040	DS75492N	1	1	
U209	IC, C-MOS, DIGITAL HEX/BUFFER, INVERTER	381830	02735	CD4050AE	1	1	
U210	IC, RESISTOR NETWORK, 39 OHM, +/-5%	412866	89536	412866	1	1	
U211	IC, C-MOS, DIGITAL	429522	04713	MC14511CP	1	1	

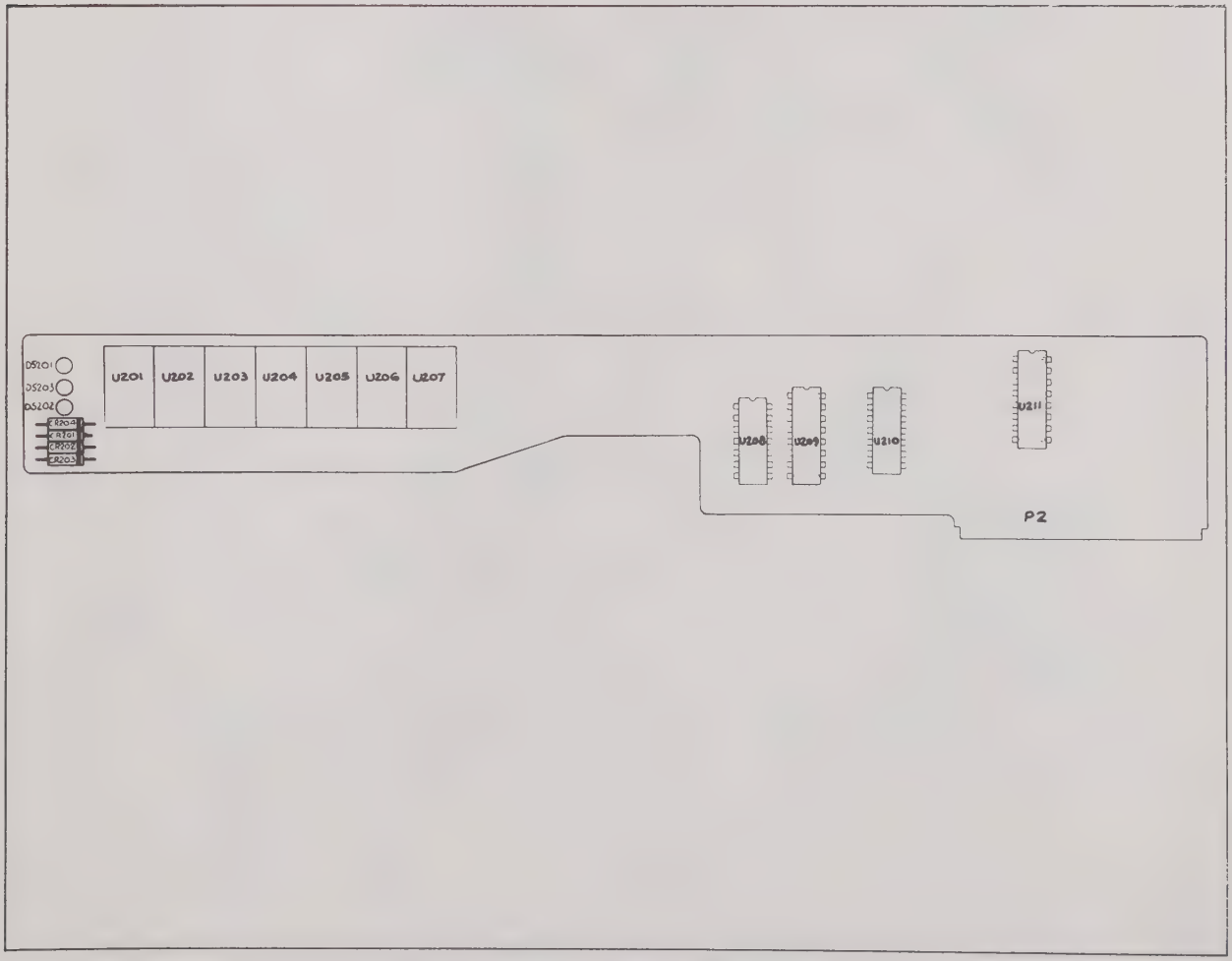

Figure 5-3. A1A2 Display PCB Assembly

Table 5-4. A1A3 250 MHz Prescaler PCB Assembly (1911A only)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1A3	250MHZ PRECALER ASSY(1911A-4003)FIG.5-4	443341	89536	443341	1		
C301	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	10		
C302	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C303	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C304	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C305	CAP,CER,0.01UF -20/+80%,25V	335786	72982	5835-000-Y5U-103Z	REF		
C306	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C307	CAP CER,MINI,5.0PF +/-0.5PF,500V	148577	72136	DN15C050D	1		
C308	CAP,CER,0.01UF +/-20%,100V	407361	72982	8121-A100-W5R-103M	REF		
C309	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C310	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C311	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C312	CAP,CER,0.01UF +/-20%,100V	407361	72982	821-A100-W5R-103M	REF		
C313	CAP,CER,0.01UF -20/+80%,25V	335786	72982	5835-000-Y5U-103Z	3		
C314	CAP,CER,0.01UF -20/+80%,25V	335786	72982	5835-000-Y5U-103Z	REF		
CR301	DIODE,HOT CARRIER	369595	07263	FH100	5	1	
CR302	DIODE,HOT CARRIER	369595	07263	FH100	REF		
CR303	DIODE,HOT CARRIER	369595	07263	FH100	REF		
CR304	DIODE,HOT CARRIER	369595	07263	FH100	REF		
CR305	DIODE,HOT CARRIER	369595	07263	FH100	REF		
F301	FUSE,0.2 AMP	370577	75915	273.200	2	10	
J3	CONN,JACK,BLACK	149112	74790	105-0753	2		
J4	CONN,RECEPTACLE, SMALL	375329	00779	85863-3	3		
Q301	XSTR,SI,NPN	453688	01295	A5T3571	2	1	
Q302	XSTR,SI,NPN	453688	01295	A5T3571	REF		
R301	RES,COMP,82 +/-5%,1/4W	108746	01121	EEB8205	1		
R302	RES,COMP, 39 +/-5%,1/2W	160036	01121	EB3905	1		
R303	RES,DEP CAR,100 +/-5%,1/4W	348771	80031	CR251-4-5P100ET	1		
R304	RES,DEP CAR,2.2K +/-5%,1/4W	343400	80031	CR251-4-5P2K2T	1		
R305	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	6		
R306	RES,DEP CAR,15+/-5%,1/4W	348755	80031	CR251-4-5P15ET	1		
R307	RES,DEP CAR,150 +/-5%,1/4W	343442	80031	CR251-4-5P150ET	1		
R309	RES,DEP CAR,270 +/-5%,1/4W	348789	80031	CR251-4-5P270ET	1		
R310	RES,VAR,CAR,10K +/-20%	385393	54869	PT10H(2.5)-10K	1	1	
R311	RES,DEP CAR,220 +/-5%,1/4W	342626	80031	CR251-4-5P220ET	1		
R312	RES,DEP CAR,560 +/-5%,1/4W	385948	80031	CR251-4-5P560ET	1		
R313	RES,DEP CAR,1K +/-5%,1/4W	343426	80031	CR251-4-5P-1KT	3		
R314	RRES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R315	RES,DEP CAR,330K +/-5%,1/4W	376640	80031	CR251-4-5P330KT	1		
R316	RES,DEP CAR,1K +/-5%,1/4W	343426	80031	CR251-4-5P-1KT	REF		
R317	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R318	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R320	RES,DEP CAR,1K +/-5%,1/4W	343426	80031	CR251-4-5P-1KT	REF		
R321	RES,DEP CAR,56K +/-5%,1/4W	441626	80031	CR251-45P56KT	1		
R322	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R323	RES,DEP CAR,270 +/-5%,1/4W	348789	80031	CR251-4-5P270ET	REF		
U301	IC,DGTL,ECL,330MHZ,DIVIDE BY 2 COUNTER	429613	52648	SP8604B	1	1	
U302	IC,DGTL,ECL,TRIPLE LINE RECEIVER	369702	18324	N10116B	1	1	
U303	IC,LIN,OP AMP	402750	12040	LM741CN	1	1	
XF301	SOCKET,SPRING TYPE,FUSE	403642	00779	50863-8	4		

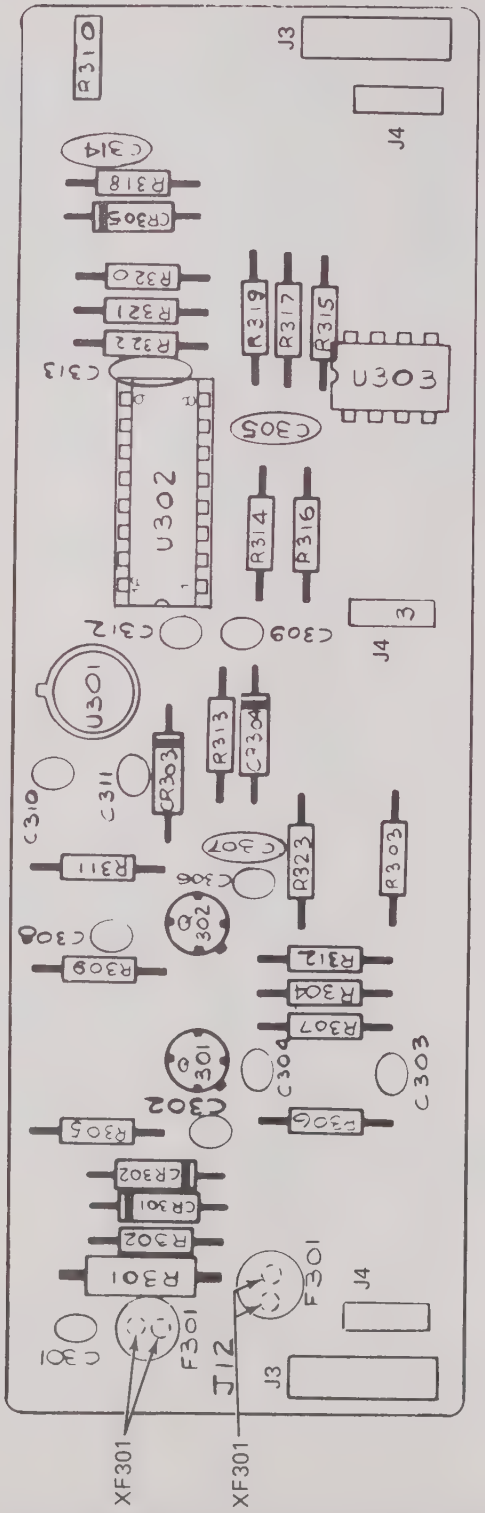

Figure 5-4. A1A3 250 MHz Prescaler PCB Assembly (1911A only)

Section 6
Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. ACCESSORY INFORMATION

6-4. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

6-5. OPTION INFORMATION

6-6. Each of the options available for this instrument if any, are described separately under headings containing the option number. The option descriptions contain applicable operating and maintenance instructions and field installation procedures. A complete list of replaceable parts for each option is contained at the end of that option description.

TABLE OF CONTENTS

OPTION/ MODEL NO.	DESCRIPTION	PAGE NO.
	ACCESSORIES	600-1
	OPTIONS	
–01	Battery Operation	601-1
-02	Data Output Unit	602-1
–03	Temperature Compensated Oscillator (TCXO)	603-1
–04	Superior Temperature Compensated Oscillator (TCXO)	603-1

Accessories

600-1. INTRODUCTION

600-2. Accessories for the Model 1910A and 1911A are described in the following paragraphs. Refer to Section 1, Table 1-2, for the list of all accessories.

600-3. CARRYING CASE (C80)

600-4. The Model C80 Carrying Case, Figure 600-1, is a soft vinyl plastic container designed for the storage and transport of the 1910A, or 1911A. The case provides the multi-counters with adequate protection against normal handling and storage conditions. A separate storage compartment is provided for test leads, power cord, and other compact accessories.

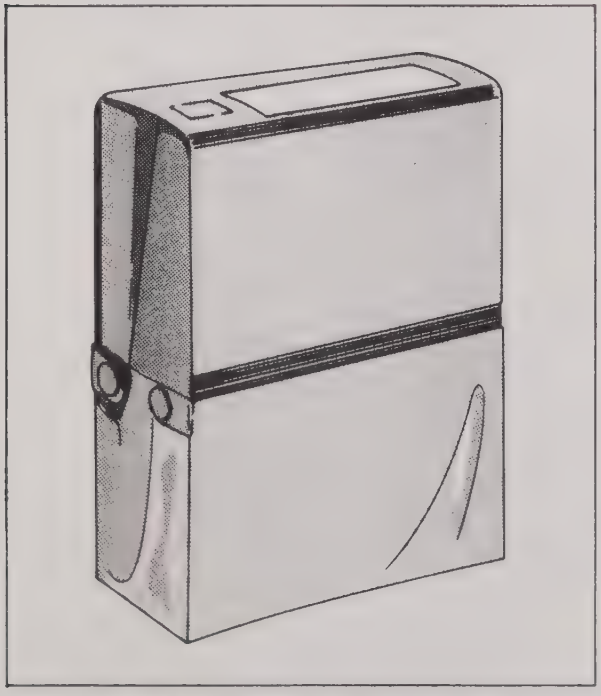

Figure 600-1. Model C80 Carrying Case

600-5. CARRYING CASE (C86)

600-6. The Model C86 Carrying Case, Figure 600-2, is a molded polyethylene container with handle designed for use in transporting the 1910A, or 1911A. This rugged case provides the counters with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads, power cord, and other compact accessories.

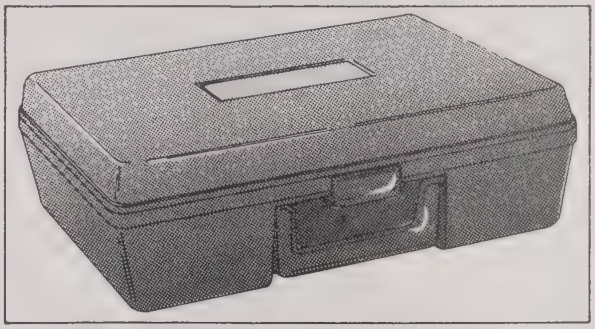

Figure 600-2. Model C86 Carrying Case

600-7. FRONT PANEL DUST COVER (MOO-100-714)

600-8. The front panel dust cover is a molded plastic snap-on accessory which fits over the front panel of the 1910A/1911A. The dust cover provides protection for the front panel controls, and is useful when storing or transporting the 1910A or 1911A.

600-9. RACK MOUNTING KITS

600-10. Introduction

600-11. Three rack mounting kits are available for mounting the 1910A or 1911A in a standard 19-inch equipment rack. The kits, listed in Table 600-1, provide the option of either offset mounting (left/right), center mounting or side-by-side mounting.

Table 600-1. Rack Mounting Kits

MOUNTING STYLE	MODEL NUMBER
Offset	MOO-200-611
Center	MOO-200-612
Side-By-Side	MOO-200-613

600-12. Installation Procedure

600-13. Installation instructions for each of the rack mounting kits is given in the following paragraphs. Use the procedure which corresponds to the model number of the kit being installed.

600-14. OFFSET AND CENTER MOUNTING KITS (MOO-200-611 and MOO-200-612)

1. Remove the multi-counters carrying handle by removing the handle disc decals and the handle mounting screws .
2. Remove screw from rear of case and separate the case from the 1910A or 1911A unit.
3. Install the side mounting brackets, as shown in Figure 600-3, and secure them to the mounting panel using the nuts provided.
4. Insert the front of the multi-counters case through the opening on the back side of the mounting panel.
5. Install the handle mounting screws through the side brackets into the handle mounting bosses. Don't over tighten these screws.
6. Slide the 1910A's or 1911A's unit through the mounting panel and into the case. Install and tighten the retaining screw at the rear of the case.

600-15. SIDE-BY-SIDE MOUNTING KIT (MOO-200-613)

1. Remove the carrying handles from both multi-counters by removing the handle disc decals and the handle mounting screws (Figure 600-5).
2. Remove the retaining screw from the rear of the cases and separate the instruments from their cases.
3. Install the center mounting bracket, as shown in Figure 600-5, and secure it to the mounting panel using the nuts provided.
4. Install the clamp screw in the center mounting bracket using the nuts and washers provided.
5. Insert the front of the instrument cases through the openings on the back side of the mounting panel. Make sure the case's handle mounting bosses are inserted into the clamp hole of the center mounting bracket.
6. Tighten the clamp screw.
7. Install the side mounting brackets and secure them to the front panel using the nuts provided.
8. Install the handle mounting screws through the side brackets into the handle mounting bosses. Don't over tighten these screws.
9. Slide the multi-counters through the mounting panel and into their cases. Install and tighten the retaining screw at the rear of both cases.

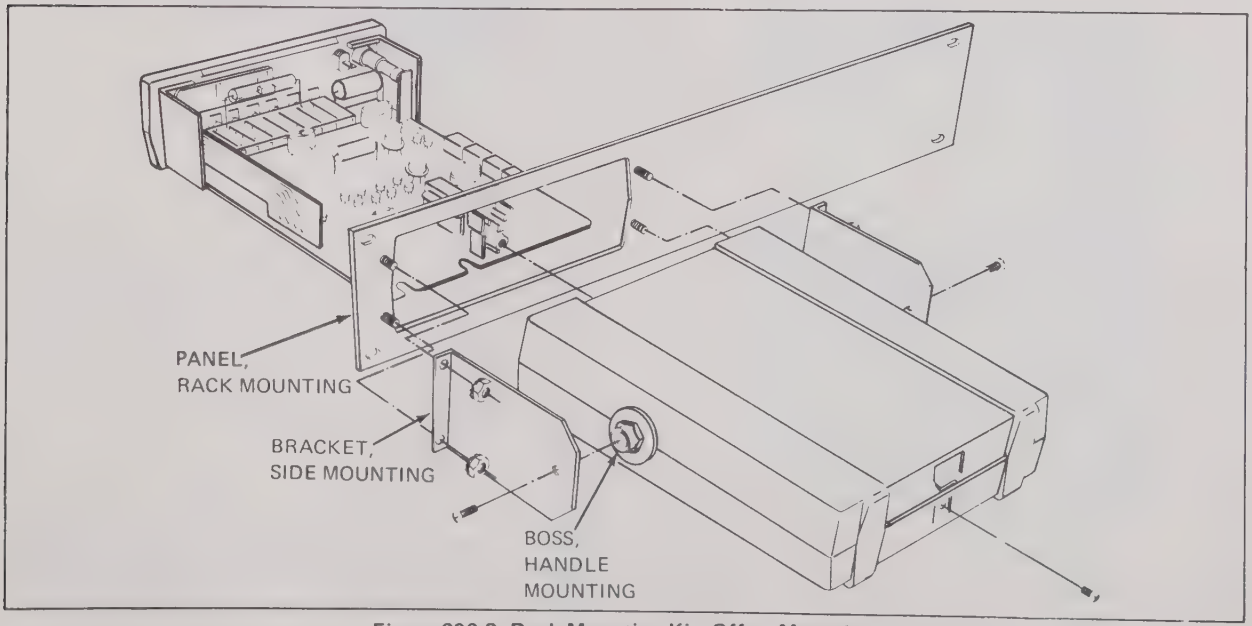

Figure 600-3. Rack Mounting Kit, Offset Mounting

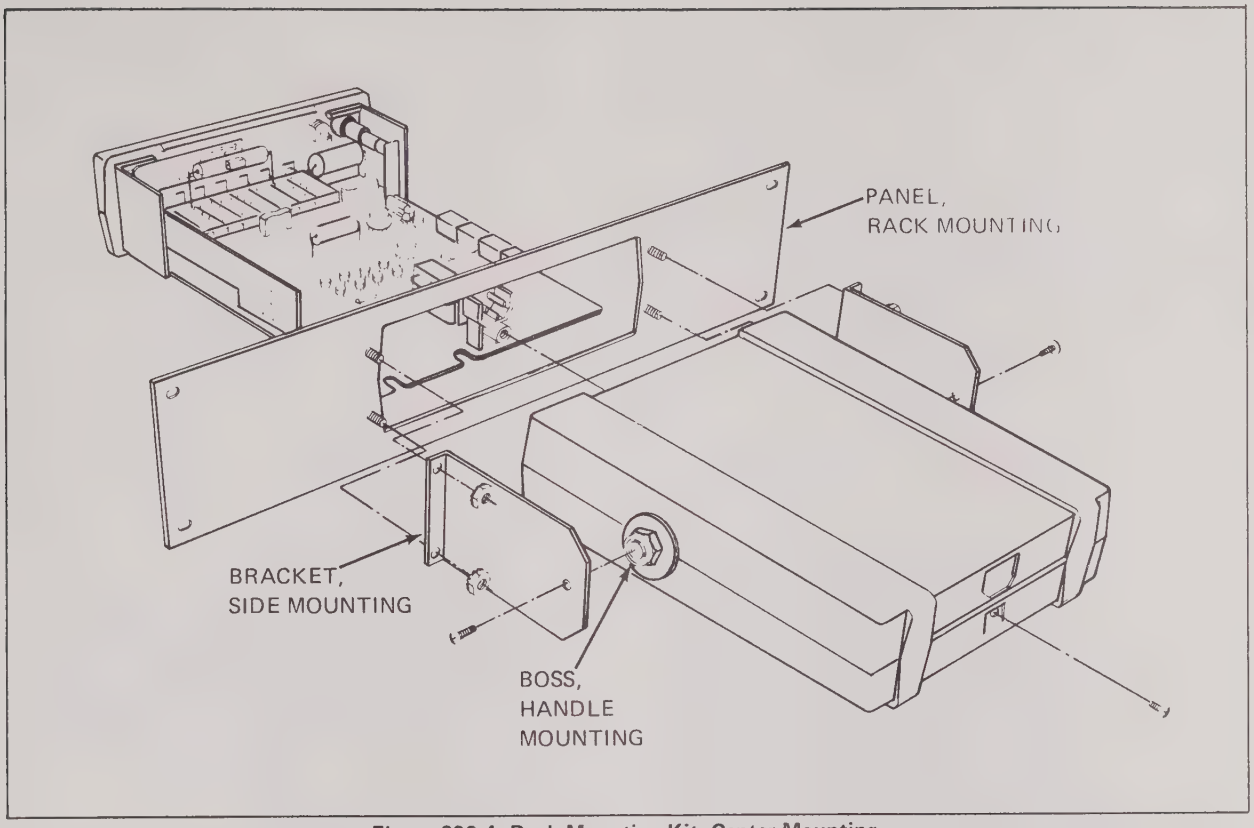

Figure 600-4. Rack Mounting Kit, Center Mounting

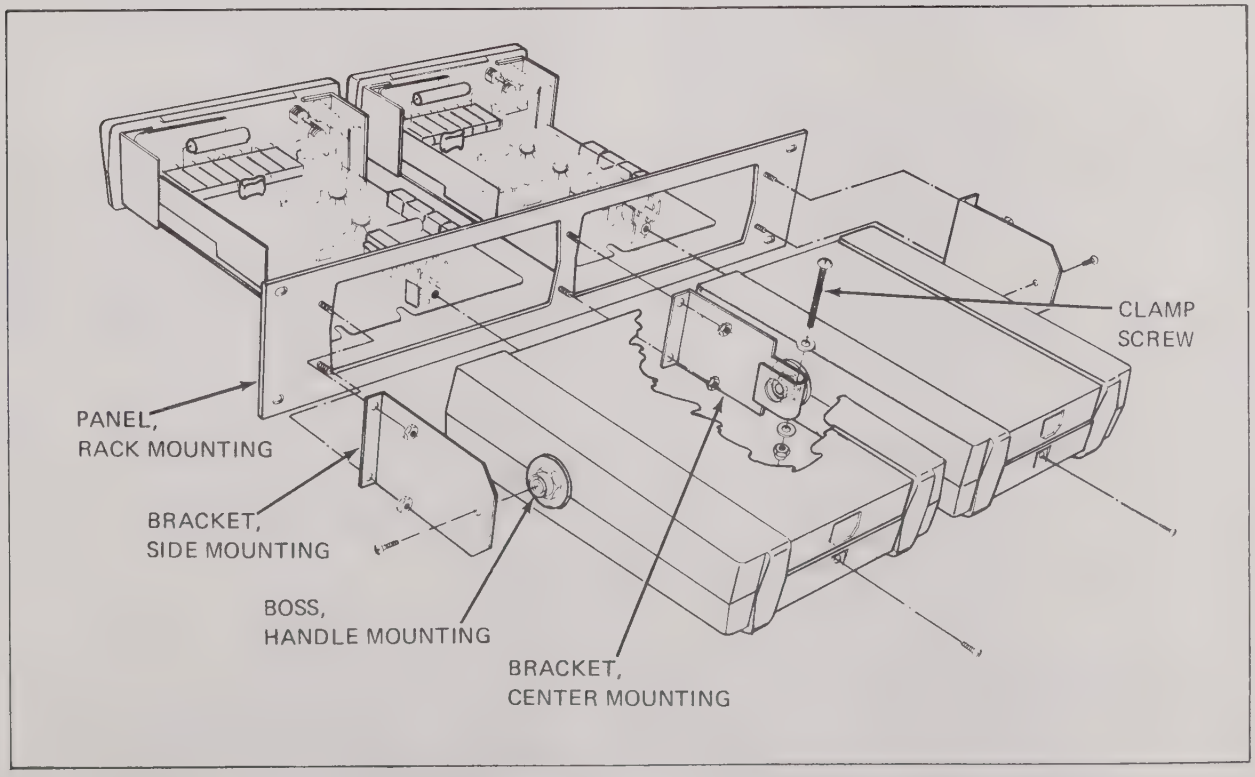

Figure 600-5. Rack Mounting Kit, Side-by-Side Mounting

Option -01
Battery Pack

WARNING

WHEN THE COUNTER IS OPERATING FROM THE BATTERY PACK THE UNIT WILL HAVE NO GROUND REFERENCE AND INPUT TO THE COUNTER MUST BE LIMITED TO A MAX OF 30V.

601-1. INTRODUCTION

CAUTION

Any attempt to charge alkaline, zinc-carbon, or mercury batteries may damage the instrument.

601-2. Power for the instrument with the -01 option installed is supplied by internal rechargeable batteries that allow the instrument to operate for at least four hours. The batteries should be recharged after every four hours of operation or when the input sensitivity falls below specifications. Recharging is most rapidly accomplished by connecting the counter to the line and depressing the POWER Switch to the STBY position.

601-3. In this way, the discharged batteries can be completely recharged in approximately 16 hours. The instrument can also be operated when recharging, however the recharging time will be significantly extended.

NOTE

Battery manufacturers recommend that nickel-cadmium batteries not be stored for extended periods of time without recharging at least every 90 days. Storage temperature below 25°C is recommended.

601-4. INPUT POWER (–01 OPTION)

601-5. To enable the unit to be compatible with international line voltages and frequencies it has been designed to operate from the following configurations: 100V 48-52 Hz, 100V 58-62 Hz, 115V 58-62 Hz, and 230 V 48-52 Hz. Therefore for battery charging purposes the AC PCB 601-4, unique for that particular line voltage and frequency must be used, (See AC PCB parts list and schematic). These modifications shall be initiated by ordering the battery option and specifying the line voltages and frequencies from which the unit shall be operated.

601-6. AC PCB

601-7. The AC PCB modifies the Main PCB -01, such that the unit is capable of charging the batteries from various input voltages and frequencies. Basically the circuit is a constant current source determined by the value of the input capacitor C601.

601-8. Inverter PCB

601-9. The Inverter PCB is a dc to dc converter used to change the +5V battery output to –12V (a level compatible with all input power configurations).

601-10.BATTERY AND FUSE REPLACEMENT

CAUTION

Disconnect the instrument from the input line power before removing batteries.

601-11. The procedure described below provides step-by-step instructions for replacing the batteries.

1. Disconnect line power cord. Remove retainer screw from rear of instrument case, and remove instrument from case.

2. On the underside of PCB, remove two threaded bolts securing battery holders in place.

3. Remove holder tops and batteries.

4. Replace batteries with 1.2 volt nickel-cadmium batteries (JF Part No. 346924). Install the batteries adhering to polarity indications on Main PCB.

NOTE

Use 1.2 volt nickel-cadmium batteries only.

601-12. The procedure described below provides step-by-step instructions for replacing the battery fuse.

1. Disconnect line power cord. Remove retainer screw from rear of instrument case, and remove instrument from its case.

2. Remove bottom shield.

3. The fuse is located directly on the underside of the main pcb. It is clearly marked (Fuse), and may be checked visually.

4. Replace fuse if necessary by ordering Part No. 167312.

Table 601-1. 1910A/1911A Final Assembly, Battery Power

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	1910A/1911A FINAL ASSEMBLY FIGURE 601-1	ORDER	MODEL	1910A-01 OR 1911A-01			
A1	MAIN PCB ASSY (10A/11A-4011)	ORDER	MODEL	1910A-01 OR 1911A-01	1		
A2	INVERTER PCB ASSEMBLY (10A/11A-4004T)	443333	89536	443333	1		
A3	AC PCB ASSEMBLY	ORDER	FOR	APPLICABLE SOURCE			
H1	SCREW, PHP, 2-56 X 1/4	149534	89536	149534			
H2	SCREW, PHP, 6-32 X 3/8	288266	89536	288266	2		
H3	WASHER, FLAT	340505	89536	340505	2		
H4	WASHER, LOCK. INT TOOTH #2	110676	89536	110676	2		
H5	SCREW,6-32 X 3/8	152165	89536	152165	1		
MP1	BASIC CASE	458331	89536	458331	1		
MP2	FOOT PAD	338632	89536	338632	2		
MP3	HANDLE, MOLDED	330092	89536	330092	1		
MP5	SHEILD, BOTTOM	458869	89536	4588369	1		
MP6	SHEILD, TOP	459248	89536	4459248	1		
MP7	SPECIFICATION DECAL	429316	89536	429316	1		
MP8	KNOB DECAL	347401	89536	347401	2		
U6	IC, P-MOS (INSTALLED IN TEST)	SEE	SECT.	5			
U7	IC, MOS (INSTALLED IN TEST)	SEE	SECT.	5			
W1	LINE CORD W/INTERNAL CONN.(NOT SHOWN)	343723	89536	343723	1		

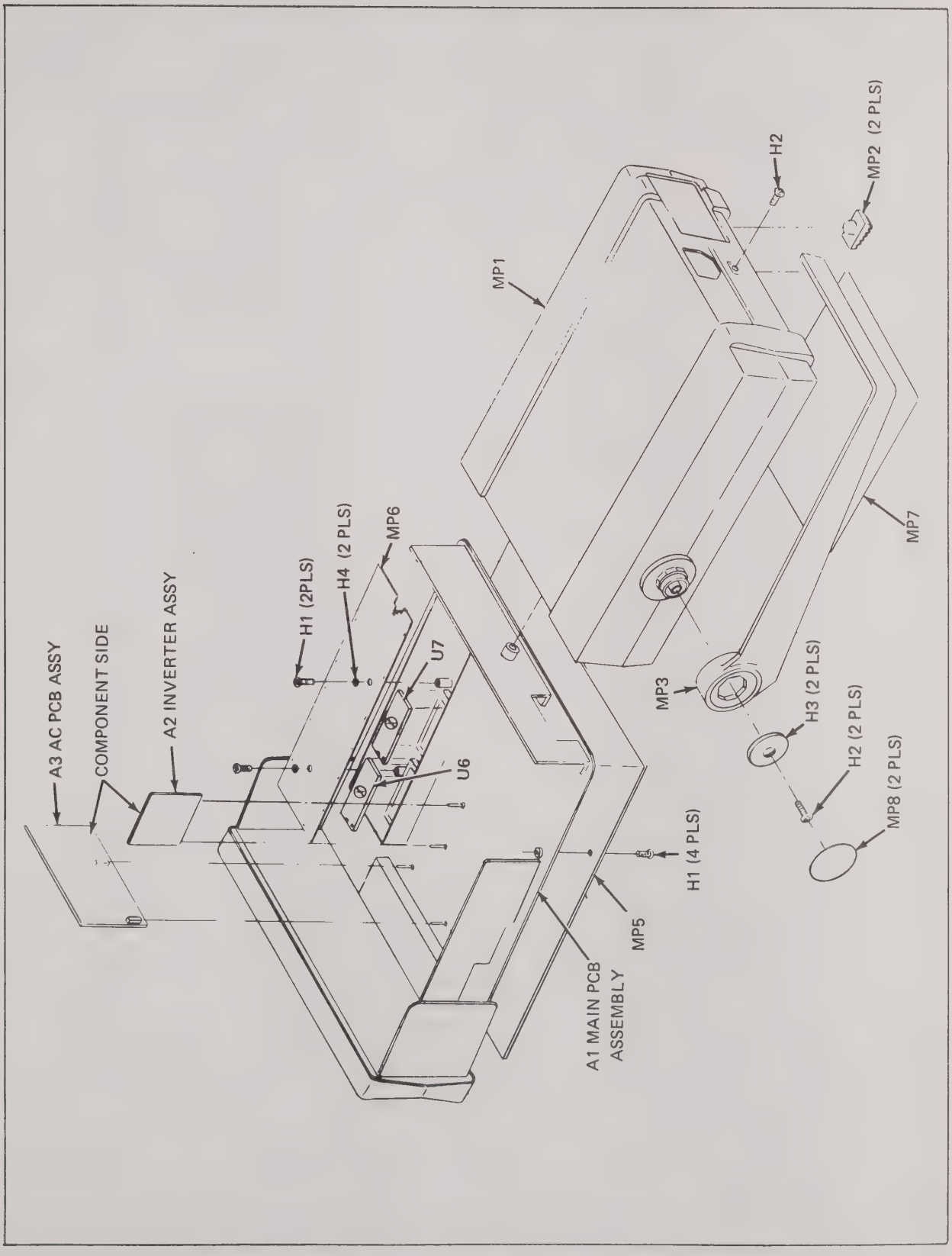

Figure 601-1. 1910A/1911A Final Assembly, Battery Power

Table 601-2. A1 Main PCB Assembly, Battery Option

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	⊗MAIN PCB ASSY,(10A/11A-4011)FIG 601-2	ORDER	MODEL	1910A-01 OR 1911A-01	1		
A1A2	DISPLAY PCB ASSY (1910A-4020T)		SEE	SECTION 5	1		
A1A3	250 MHZ PRESCALER PCB ASSY (1911A-4003T)		SEE	SECTION 5	1		
BT1	BATTERY,NI-CAD	346924	06001	41B004AD15	4	4	
BT2	BATTERY,NI-CAD	346924	06001	41B004AD15	REF		
BT3	BATTERY,NI-CAD	346924	06001	41B004AD15	REF		
BT4	BATTERY,NI-CAD	346924	06001	41B004AD15	REF		
C1	CAP,ELECT,10,000UF,-10/+100%,6V	387241	25088	B41010/100006	1	1	
C4	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	6		
C5	CAP,VAR,7PF-25PF,350V	229948	72982	538-006B-07-25	1	1	
C6	CAP,CER,22PF,+/-20%,10KV	369157	72982	831-000-00G0-220	4		
C7	CAP,CER,47PF,+/-20%,1000V	369132	56289	C0C030B102H-470J	1		
C8	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C9	CAP,CER 0.001UF +/-10%,1KV	368621	71590	DD-102	1		
C10	CAP,POLY STR,FILM,1UF,+/-10%,400V	447537	73445	C280MAF/A100K	1		
C11	CAP,CER,100PF,+/-10%,1KV	105593	71590	DD101	1		
C12	CAP,CER,22PF,+/-20%,10KV	369157	72982	831-000-00G0-220	REF		
C13	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	7		
C14	CAP,TA,22UF,+/-20%,15V	423012	56289	196D226X-0015KA1	2		
C15	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	5		
C16	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C17	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C18	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102N	REF		
C19	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C20	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102N	REF		
C21	CAP,CER,22PF,+/-20%,10KV	369157	72982	831-000-00G0-220	REF		
C22	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102N	REF		
C23	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C24	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C25	CAP,CER,0.01UF,+/-20%,100V	149153	56289	C023B101F-103M	REF		
C26	CAP,TA,1UF +/-20%,35V DCW	161919	56289	196D105X-0035JA1	1		
C27	CAP,CER,0.01UF +/-20%,100V	407361	72982	812-A100-W5R-103M	1		
C28	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C29	CAP,CER,0.0012UF,+/-10%,500V DCW	106732	71590	CF122	1		
C30	CAP,TA,22UF,+/-20%,15V	423012	56289	196D226X-0015KA1	REF		
C31	CAP,TA,10UF,+/-20%,15V	193632	56289	196D106X-0015KA1	REF		
C32	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C33	CAP,CER,1000PF,+/-20%,100V	402966	72982	8121-A100-W5R-102M	REF		
CR1	DIODE,SI,RECTIFIER	343491	04713	1N4002	2	1	
CR2	DIODE,SI,RECTIFIER	343491	04713	1N4002	REF		
CR6	DIODE,HI-SPEED SWITCHING	203323	07910	1N4448	3	1	
CR7	DIODE,HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR8	DIODE,LO-CAP	381806	07910	1N3062	2	1	
CR9	DIODE,LO-CAP	381806	07910	1N3062	REF		
CR11	DOIDE,ZENER,400MW,+/-5%,6.8V	260695	07910	1N754A	1	1	
CR12	DIODE,HI-SPEED SWITCHING	203323	07910	1N4448	REF		
F1	FUSE,SLO-ACTNG,1/2 AMP	109322	71400	MDL1-2	1	5	
F2	WIRE #42 (USED AS A FUSE,NOT SHOWN)	167312	89536	167312	AR		
H1	LUG,SOLDER	151431	79963	329	2		
H2	LUG,SOLDER	441972	79963	761	1		
H3	NUT,HEX 1/4 - 32	110601	89536	110601	1		
H4	NUT,HEX,4-40	110635	89536	110635	2		
H5	NUT,HEX,6-32	110551	89536	110551	2		
H6	SCREW,PHP 4-40 X 1/4	129890	89536	129890	4		
H7	SCREW,6-32 X 1.56	347427	89536	347427	2		
H8	SCREW,S.T.,6-32 X 3/16	381087	89536	381087	2		
H9	WASHER,INT LOCK #4	110403	89536	110403	3		
J1	RECEPTACLE,BNC	152033	95712	30355-1	3		
J8	RECEPTACLE,BNC	152033	95712	30355-1	REF		
J12	RECEPTACLE,BNC (1911A ONLY)	152033	95712	303551	REF		
MP1	ABSORBANT DISC	458653	89536	458653	4		
MP2	ABSORBANT PAD	458661	89536	458661	2		

Table 601-2. A1 Main PCB Assembly, Battery Option (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
MP3	CABLE CLAMP (NOT SHOWN)	172080	06383	SST-1M	1		
MP4	DECAL FRONT PANEL (1910A-01 ONLY)	453977	89536	453977	1		
MP5	DECAL FRONT PANEL (1911A-01 ONLY)	453951	89536	453951	1		
MP6	DECAL,XFMR WARNING (NOT SHOWN)	386250	89536	386250	1		
MP7	CONTACT BATTERY	344200	89536	344200	8		
MP8	CABLE TIE	331157	06383	PLT2M	1		
MP9	RETAINER	352484	77969	9109-E	1		
MP10	TERMINAL PINS	376574	00779	3-87022-1	7		
MP11	HOLDER,BATTERY	390450	89536	390450	4		
MP12	KNOB,POINTER	448803	89536	448803	1		3
MP13	LENS,FRONT	456582	89536	456582	1		
MP14	PANEL,REAR	443291	89536	443291	1		
MP15	PANEL,FRONT	443283	89536	443283	1		
MP16	SHEILD,WALL	459230	89536	459230	1		
MP17	PIN,GUIDES	375840	89536	375840	6		
MP18(F1)	FUSE INSERT	460238	89536	460238	1		
Q1	XSTR,FET,JUNCTION,N-CHANNEL	288324	89536	288324	1	1	
Q2	XSTR,FET,JUNCTION,N-CHANNEL	404277	89536	404277	1	1	
Q3	XSTR,SI,PNP	195974	04713	2N3906	4	1	
Q4	XSTR,SI,PNP	195974	04713	2N3906	REF		
Q5	XSTR,SI,PNP	195974	04713	2N3906	REF		
Q6	XSTR,SI,PNP	195974	04713	2N3906	REF		
Q7	XSTR,SI,NPN	218396	04713	2N3904	5	1	
Q8	XSTR,FET,JUNCTION,N-CHANNEL	386094	89536	386094	1	1	
Q9	XSTR,SI,NPN	218396	04713	2N3904	REF		
Q10	XSTR,SI,NPN	218396	04713	2N3904	REF		
Q11	XSTR,SI,NPN	218396	04713	2N3904	REF		
Q12	XSTR,SI,NPN	218396	04713	2N3904	REF		
R1	RES,DEP CAR,1K +/-5% 1/4W	343426	80031	CR251-4-5P1KT	6		
R2	RES,DEP CAR,1M +/-5%,1/4W	348987	80031	CR251-4-5P1MT	4		
R3	RES,DEP CAR,2.7K +/-5%,1/4W	386490	80031	CR251-4-5P2K7T	3		
R4	RES,DEP CAR,180 +/-5%,1/4W	441436	80031	CR251-4-5P180ET	2		
R5	RES,DEP CAR,560 +/-5%,1/4W	385948	80031	C5251-4-5P560ET	5		
R6	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	9		
R7	RES,DEP CAR,1M +/-5%,1/4W	348987	80031	CR251-4-5P1MT	REF		
R8	RES,DEP CAR,150 +/-5%,1/4W	343442	80031	CRCR251-4-5P150ET	2		
R9	RES,DEP CAR,1M +/-5%,1/4W	348987	80031	CR251-4-5P1MT	REF		
R10	RES,DEP CAR,2.7K +/-5%,1/4W	386490	80031	CR251-4-5P2K7T	REF		
R11	RES,VAR,CAR,COMP,10K +/-20%,0.2W	369553	54869	PT10V-10K	1	1	
R12	RES,SWITCH/POTENTIOMETER,10K	443044	89536	443044	1		
R13	RES,DEP CAR,22K +/-5%,1/4W	348870	80031	CR251-4-5P22KT	2		
R14	RES,DEP CAR.150K +/-5%,1/4W	348938	80031	CR251-45P150KT	1		
R15	RES,DEP CAR,1.5K +/-5%,1/4W	343418	80031	CR251-4-5P1K5T	2		
R16	RES,DEP CAR,1.5K +/-5%,1/4W	343418	80031	CR251-4-5P1K5T	REF		
R17	RES,DEP CAR,22K +/-5%,1/4W	348870	80031	CR251-4-5P22KT	REF		
R19	RES,DEP CAR,560 +/-5%,1/4W	385948	80031	C5251-4-5P560ET	REF		
R20	RES,VAR,CERMET,10K +/-10%,1/2W	309674	89536	309674	1		
R21	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R22	RES,DEP CAR,100K +/-5%,1/4W	348920	80031	CR251-4-5P100KT	3		
R23	RES,DEP CAR,1K +/-5% 1/4W	343426	80031	CR251-4-5P1KT	REF		
R24	RES,DEP CAR,1.2K +/-5%,1/4W	441378	80031	251-4-5P1K2T	REF		
R25	RES,DEP CAR,270 +/-5%,1/4W	348789	80031	CR251-4-5P270ET	1		
R26	RES,DEP CAR,220 +/-5%,1/4W	342626	80031	CR251-4-5P220ET	1		
R27	RERES,DEP CAR,33 +/-5%,1/4W	414524	80031	CR251-4-5P33ET	1		

Table 601-2. A1 Main PCB Assembly, Battery Option (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R28	RES,DEP CAR,560 +/-5%,1/4W	385948	80031	C5251-4-5P560ET	REF		
R29	RES,DEP CAR,1K +/-5% 1/4W	343426	80031	CR251-4-5P1KT	REF		
R30	RES,DEP CAR,2.7K +/-5%,1/4W	386490	80031	CR251-4-5P2K7T	REF		
R31	RES,DEP CAR,150 +/-5%,1/4W	343442	80031	CRCR251-4-5P150ET	REF		
R32	RES,DEP CAR,1K +/-5% 1/4W	343426	80031	CR251-4-5P1KT	REF		
R33	RES,DEP CAR,560 +/-5%,1/4W	385948	80031	C5251-4-5P560ET	REF		
R34	RES,DEP CAR,1K +/-5% 1/4W	343426	80031	CR251-4-5P1KT	REF		
R35	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R36	RES,DEP CAR,100K +/-5%,1/4W	348920	80031	CR251-4-5P100KT	REF		
R37	RES,DEP CAR,1M +/-5%,1/4W	348987	80031	CR251-4-5P1MT	REF		
R38	RES,DEP CAR,1K +/-5% 1/4W	343426	80031	CR251-4-5P1KT	REF		
R39	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R41	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R42	RES,DEP CAR,27 +/-5%,1/4W	348763	80031	CR251-4-5P27ET	2		
R43	RES,DEP CAR,27 +/-5%,1/4W	348763	80031	CR251-4-5P27ET	REF		
R44	RES,DEP CAR,4.7K +/-5%,1/4W	348821	80031	CR251-4-5P4K7T	REF		
R45	RES,DEP CAR,4.7K +/-5%,1/4W	348821	80031	CR351-4-5P4K7T	REF		
R46	RES,DEP CAR,560 +/-5%,1/4W	385948	80031	C5251-4-5P560ET	REF		
R48	RES,DEP CAR,180 +/-5%,1/4W	441436	80031	CR251-4-5P180ET	REF		
R49	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R50	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R51	RES,DEP CAR,100K +/-5%,1/4W	348920	80031	CR251-4-5P100KT	REF		
R52	RES,DEP CAR,10K +/-5%,1/4W	348839	80031	CR251-4-5P10KT	REF		
R54	RES,COMP,47 +/-5% 1/4W	147892	U121	CB4705	1		
S1	BUTTON,GREEN	445197	89536	445197	1		
S1 - S13	SWITCH ASSEMBLY	429589	89536	429589	1		
S2	BUTTON,GREEN	445205	89536	445205	1		
S4	BUTTON,DARK GREY	426759	89536	426759	6		
S5	BUTTON,DARK GREY	426759	89536	426759	REF		
S6	BUTTON,DARK GREY	426759	89536	426759	REF		
S7	BUTTON,DARK GREY	426759	89536	426759	REF		
S8	BUTTON,LIGHT GREY	425900	89536	425900	5		
S9	BUTTON,LIGHT GREY	425900	89536	425900	REF		
S10	BUTTON,LIGHT GREY	425900	89536	425900	REF		
S11	BUTTON,LIGHT GREY	425900	89536	425900	REF		
S12	BUTTON,LIGHT GREY	425900	89536	425900	REF		
S13	BUTTON,DARK GREY	426759	89536	426759	REF		
S14	SWITCH,SLIDE	354878	95146	MSS22504	1	1	
S15	SEE R12						
T1	XFMR,BATTERY OPTION	463802	89536	463802	1		
U1	IC,CKT,ANALOG BIPOLAR DC WIDEBAND PREAMP	429191	89536	429191	1	11	
U2	IC,DGTL,ECL,EDGE TRIGGERED JK FLIP-FLOP	402743	12040	F95029DC	1	1	
U3	IC,TTL,DUAL,JK TRIGGERED FLIP-FLOP	363440	01295	SN74S112N	2	1	
U4	IC,TTL,DUAL,JK TRIGGERED FLIP-FLOP	363440	01295	SN74S112N	REF		
U5	IC,DGTL,QUAD,2-INPUT,POS NOR GATE	288845	01295	SN7402N	1	1	
U6	Ⓐ SEE FINAL ASSEMBLY PARTS LIST						
U7	Ⓐ SEE FINAL ASSEMBLY PARTS LIST						
U8	IC,TTL,50MHZ DECADE COUNTER	320754	01295	SN74196N	1	1	
U9	IC,DGTL,TTL MSI,DECADE COUNTER	402545	01295	SN74LS90N	1	1	
U10	IC,DGTL,MOS TO LED HEX DIGIT DRIVER	429506	12040	DS75492N	1	1	
U15	IC,LINEAR TIMER	402610	12040	LM555CN	1	1	
W1	CABLE ASSEMBLY (1911A ONLY)	468983	89536	468983	1		
XF1	FUSE HOLDER ASSEMBLY	460329	89536	460329	1		
XU1	SOCKET,IC,18 PIN	413229	91506	318-AG39D	1		
XU2	SOCKET,IC,16 PIN	276535	91506	316-AG39D	1		
XU6	SOCKET,IC,40 PIN	386060	09922	D1LB40P-1	2		
XU7	SOCKET,IC,40 PIN	386060	09922	D1LB40P-1	REF		
Y1	CRYSTAL,10MHZ	385732	89536	385732	1		

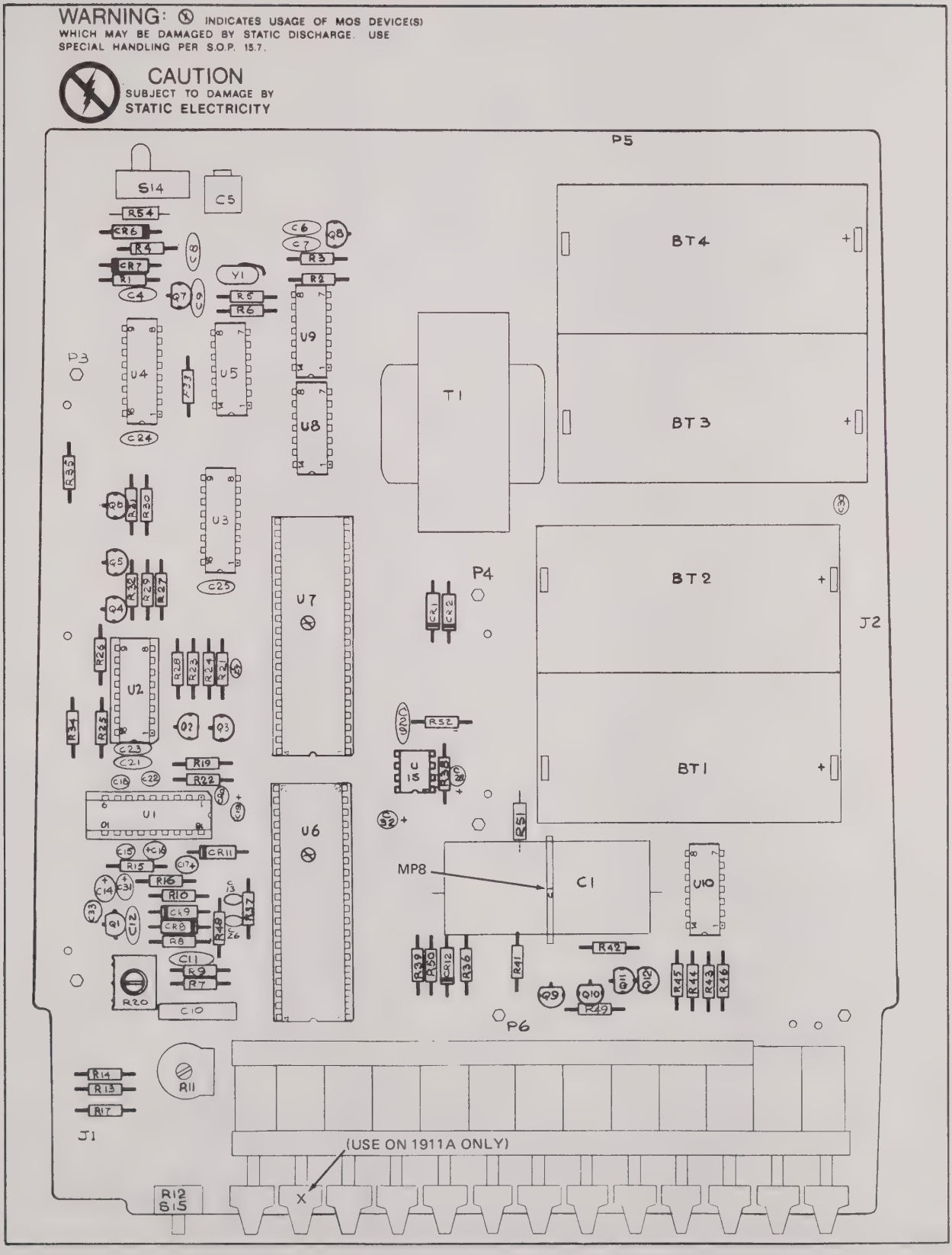

Figure 601-2. A1 Main PCB Assembly, Battery Option (Sht. 1 of 3)

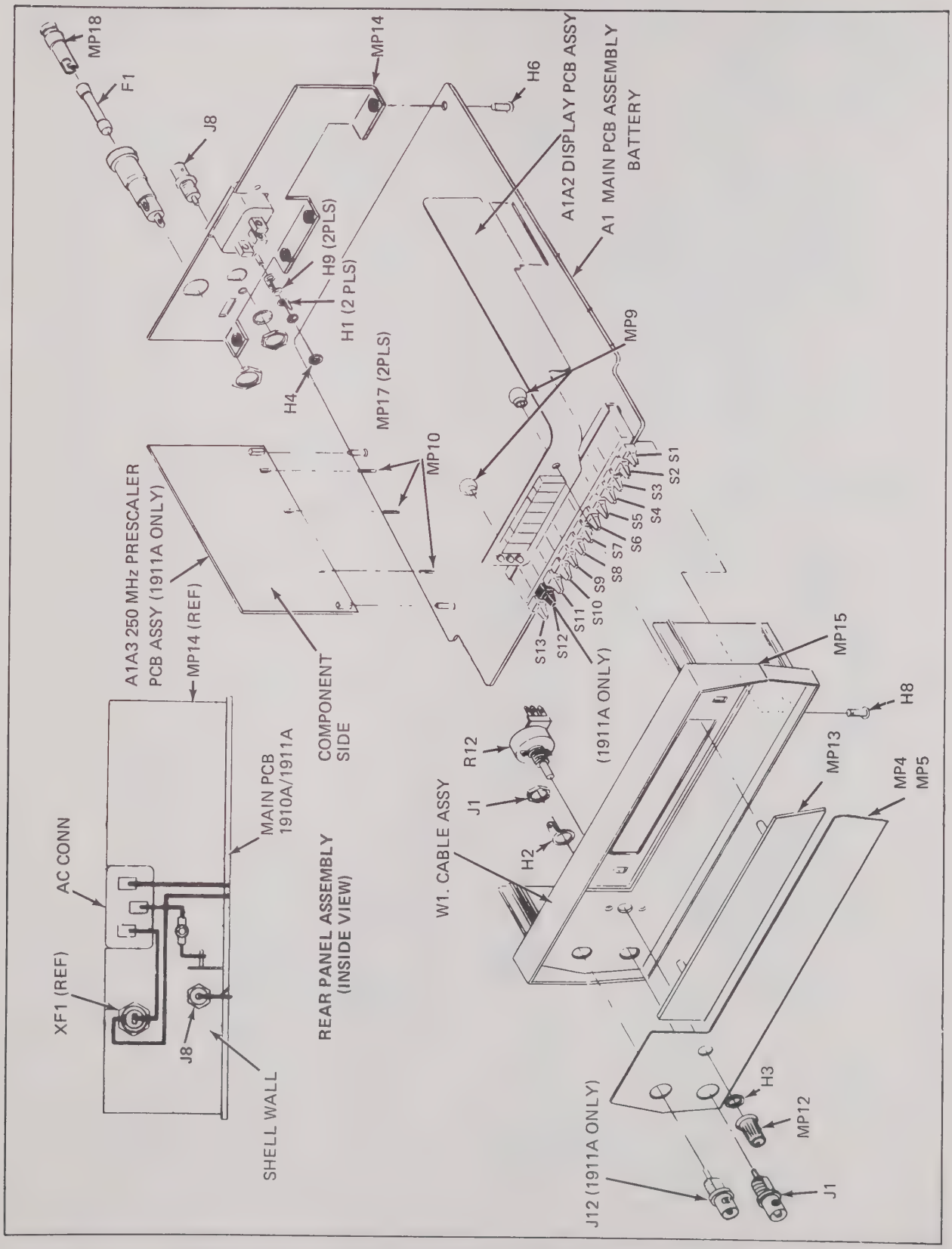

Figure 601-2. A1 Main PCB Assembly, Battery Option (Sheet 2 of 3)

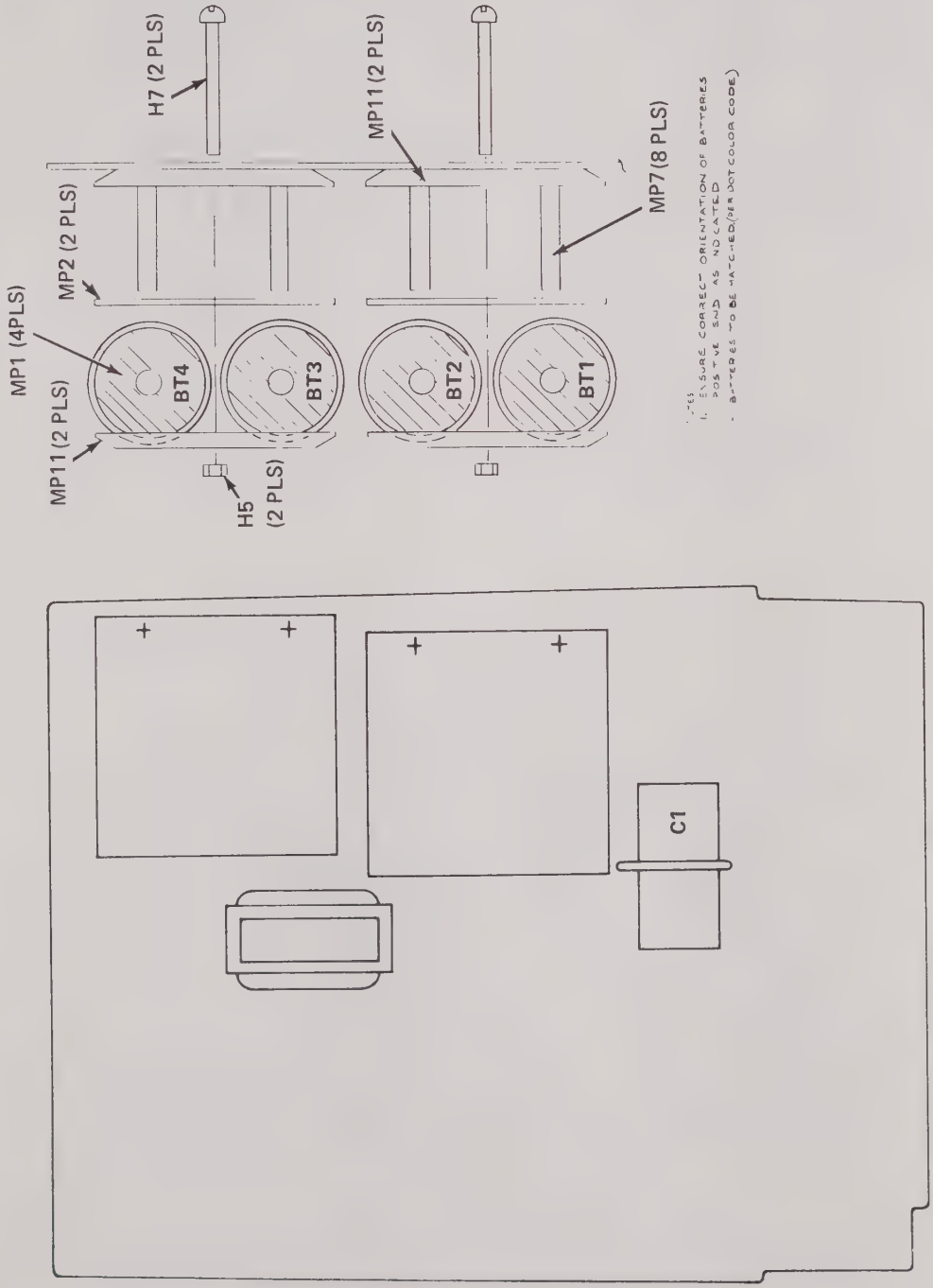

Figure 601-2. A1 Main PCB Assembly, Battery Option (Sheet 3 of 3)

Table 601-3. A2 Inverter PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	INVERTER PCB ASSEMBLY,FIGURE 601-3	443333	89536	443333	1		
C401	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	3		
C402	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
C403	CAP,CER,0.1UF,+/-GMV,20V MIN.	369199	71590	UK-10-1041	1		
C404	CAP,CER,47PF,+/-20%,1000V	369132	56289	C030B102-H470J	1		
C405	CAP,TA,10UF,+/-20%,15V	193623	56289	196D106X-0015KA1	REF		
L401	CHOKE, 6-TURN	320911	89536	320911	1		
Q401	XSTR,SI,NPN	218396	04713	2N3904	2	1	
Q402	XSTR,SI,NPN	218396	04713	2N3904	REF		
R401	RES,DEP CAR,220, +/-5%,1/4W	342626	80031	CR251-4-5P220ET	1		
R402	RES,DEP CAR,82,+/-5%,1/4W	442277	80031	CR251-4-5P82ET	1		
R403	RES,DEP CAR,22,+/-5%,1/4W	381145	80031	CR251-4-5P22ET	1		
T401	XFMR, INVERTER	462093	89536	462093	1		
U401	IC,LINEAR,NEG VOLT REG 3-TURN	429514	07263	79M12HC	1	1	
XU401	TRANSIPAD	152207	07047	10123DAP	1		

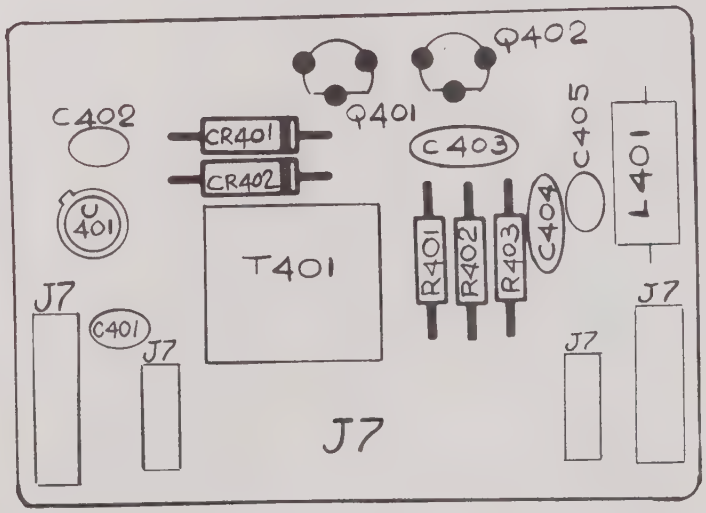

Figure 601-3. A2 Inverter PCB Assembly

Table 601-4. A3 AC PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	AC PCB ASSEMBLY,FIGURE 601-4	ORDER	FOR	REQUIRED SOURCE	1		
	AC PCB ASSY,115V SOURCE,58-62 HZ (10A/11A-4006T)	456251	89536	456251	1		
	AC PCB ASSY,230V SOURCE,48-52 HZ (10A/11A-4013T)	459362	89536	459362	1		
	AC PCB ASSY,100V SOURCE,48-52 HZ (10A/11A-4012T)	459370	89536	459370	1		
	AC PCB ASSY,100V SOURCE,58-62 HZ (10A/11A-4014T)	463307	89536	463307	1		
C601	CAPACITOR (SEE BELOW)	ORDER	FOR	REQUIRED SOURCE	1		
	CAP,MYLAR,6UF,+/-5%,200V DC,58-62 HZ USED ON 115V SOURCE	393546	06739	D2-505D	1		
	CAP,POLPRPLN,3.3UF,+/-5%,300V,48-52 HZ USED ON 230V SOURCE	380253	89536	394197	REF		
	CAP,MYLAR,6.0UF,+/-5%,115V,58-62 HZ	393546	89536	393546	1		
	CAP,MYLAR,6.6UF,+/-5%,300V,48-52 HZ USED ON 100V SOURCE	394189	89536	394189	1		
CR601	DIODE,ZENER,UNCOMP,40V	407825	12969	UZ8740	2	1	
CR602	DIODE,ZENER,UNCOMP,40V	407825	12969	UZ8740	REF		
H1	CABLE TIE	331157	06383	PLT2M	1		
J7	CONN,RECEPTACLE	375329	00779	85863-3	2		
J8	PLUG/JACK PCB TEST	149112	74970	105-0753	2		
R601	RES,DEP CAR,1M,+/-5%,1/4W	348987	80031	CR251-4-RP1MT	1		

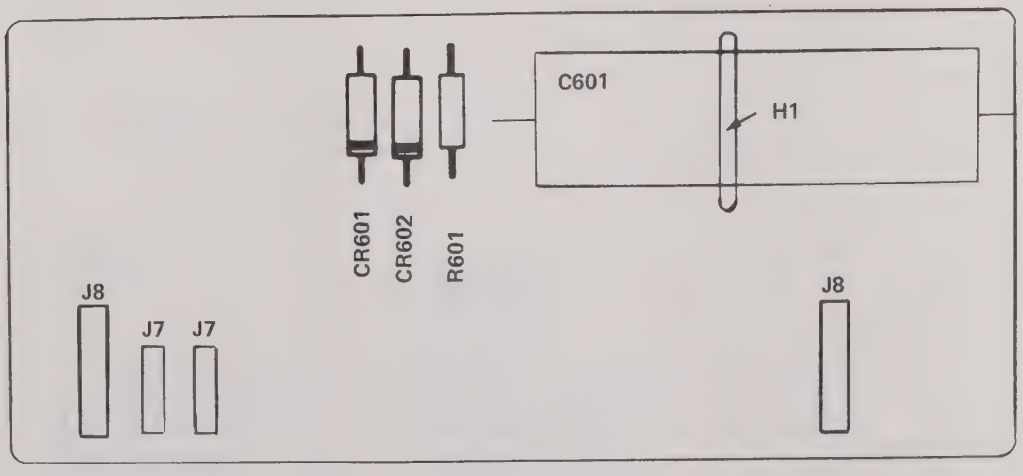

Figure 601-4. A3 AC PCB Assembly

Option -02
Data Output Unit

602-1. INTRODUCTION

602-2. The DOU consists of 18 data lines containing all the display data necessary for external logging. The data lines are output on an extender PCB at the rear of the instrument. Due to space limitation the instrument may be ordered with either option –01 or –02, but not both.

602-3. OPERATION

602-4. The output data available at the rear panel DOU connector is listed in Table 602-1. The encoded input data to position the decimal in the frequency and period modes are given in Tables 602-2 and 602-3 respectively. To interface the DOU with an external logging unit see theory of operation of this section.

602-5. THEORY OF OPERATION

602-6. The DOU's output on connector J5 is obtained directly from the latches contained in U7. Its timing sequence is therefore exactly the same as the display strobe cycle (see Figure 602-1). Because the displays are strobed serially the output data on the DOU is also serial, and any external logging system interfaced with the DOU must be capable of using serial data or it must have its own serial to parallel converter.

602-7. The decimal point positioning and unit annunciators are enabled simultaneously with the selection of a range (see Table 602-2 for frequency mode encoding and Table 602-3 for period mode encoding).

Table 602-1. DOU Output Data

Pin No. (J5)	Nomenclature	Function
1 & 3		Ground
2 & 4	Not used	
5	B1 (Blanking)	Blanks leading Zero
6	D, (8)	BCD Information
7	C, (4)	BCD Information
8	B, (2)	BCD Information
9	A, (1)	BCD Information
10	Dsl, (digit–1 strobe)	Enable 1st digit LED, (LSD, - strobed last)
11	DS2, (digit –2, strobe)	Enable 2nd LED, (2SD)
12	DS3, (digit–3 strobe)	Enable 3rd LED, (3SD)
13	DS4, (digit–4 strobe)	Enable 4th LED, (4SD)
14	DS5, (digit–5 strobe)	Enable 5th LED, (5SD)
15	DS6, (digit–6 strobe)	Enable 6th LED, (6SD)
16	Ovf1, (overflow)	Enable overflow annunciator, (goes high following MUP if carry out of MSD
17	DP, (decimal position)	Occurs simultaneously with digit strobe.
18	UX, (Units enable)	Enable units annunciator simultaneously with digit strobe lines.
19	DS7 (digit 7 strobe)	Enable 7th LED, (MSD, strobed first)
20	M memory update	Indicates new data being entered.

Table 602-2 Decimal Positioning (Frequency Mode)

Encoded Input to U6 (Frequency Mode)			Gate Time	Decimal Location (Display LED)	Annunciator
22	23	24			
0	1	0	10 msec	D5	MHz
1	1	0	0.1 sec	D3	kHz
0	0	1	1.0 sec	D4	kHz
1	0	1	10 sec	D5	kHz
1	1	1	Autorange	*	*

**In autorange the gate time varies between 0.1 and 1 sec.*
Decimal and units corresponds to gate time as listed above.

Table 602-3 Decimal Positioning (Period Mode)

Encoded Input to U6 (Period Mode)			Cycles	Decimal Location (Display LED)	Annunciator
22	23	24			
0	0	0	■	D5	msec
1	0	0	■	D6	msec
0	1	0	■	D4	usec
1	1	0	■	D5	usec
1	1	1	Autorange	*	*

**Autoranges through all four of the above ranges plus 10^4 periods averaged, which is D6 and usec's.*
■ *Not a fixed value.*

NOTE

The drive capability of all data outputs in PMOS; able to sink 0.16 mA at logic 0 or source 0.16mA for logic 1 levels.

602-8. DOU Output Timing

602-9. The timing diagram of Figure 602-1 is for one test case in which an input signal of 3.8 MHz is applied to channel A, frequency mode, with 10 Hz resolution.

NOTE

The DOU data is output on connector J4 in bcd format serially, and is valid only on the positive edge of memory update (M).

602-10. DOU Interface Cable

602-11. A mating DOU connector is supplied as part of the –02 option for use in fabricating a custom interface cable. Use the following procedure to fabricate the interface cable:

1. Assemble the following equipment:
   a. Teflon or vinyl insulated wire, 26 gauge, 20 pieces cut to desired length.
   b. Sleeving, # 16 for vinyl insulated wire, or # 18 for teflon insulated wire.
   c. Rosin core solder, 60/40
   d. Wire strippers
   e. Soldering Iron, pencil-type (45W max.)
   f. DOU mating connector
   g. Mating connector for interfaced instrument
   h. Connector vice
2. Slide cable wires through the DOU connector backshell (hood) as shown in Figure 602-2.
3. Strip one-eighth of an inch of insulation from the DOU connector end of the cable. Tin the ends.
4. Cut 20 pieces of sleeving to a length of three-sixteenths of an inch.
5. Slide one piece of sleeving over each prepared wire end.

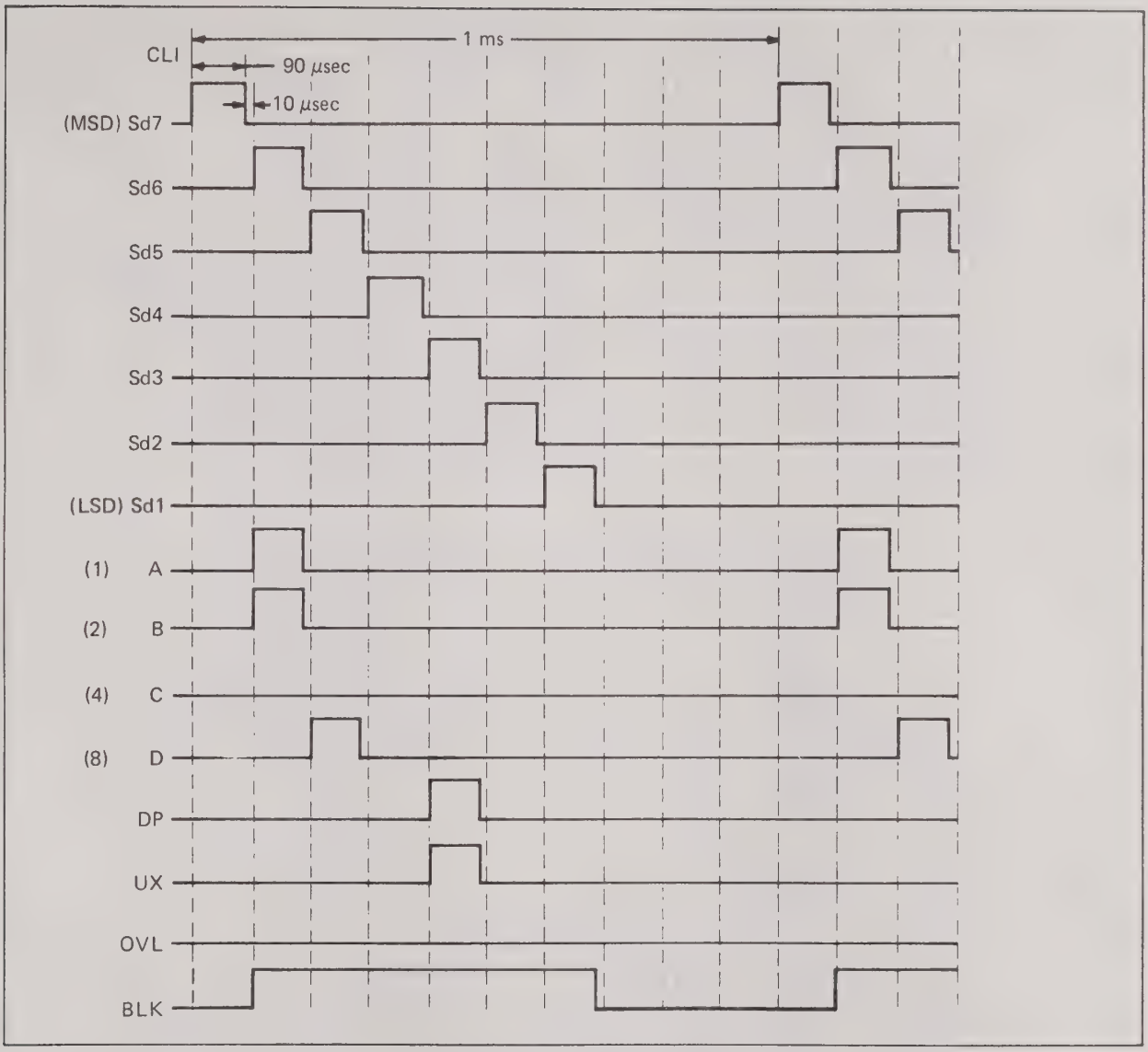

Figure 602-1. DOU Timing Diagram

6. Place the DOU mating connector in the connector vice, and tin each connector pin.

7. Solder one prepared wire to each connector pin.

8. Position the sleeving over the solder joints, and install the connector backshell (hood) and strain relief as shown in Figure 602-2.

9. Install the wires on the mating connector for the interfaced instrument using the DOU connector information given in Table 602-1.

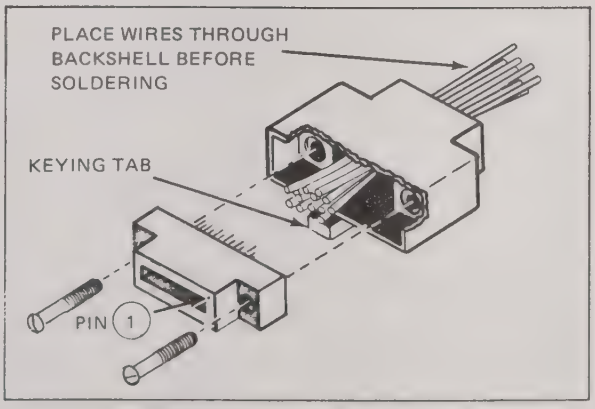

Figure 602-2. DOU Connector

Table 602-4. DOU PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DOU ASSY,FIGURE 602-3 (SHEET 1 OF 2)	ORDER	1910A	-02 OR 1911A-02	1		
	DOU PCB ASSEMBLY (10A/11A-4005)	ORDER	NEXT	HIGHER LEVEL	1		
H1	SCREW,PHP,4-40 X 1/4	129890	73734	19022	2		
H2	SCREW,PHP,6-32 X 1/4 (NOT SHOWN)	152140	73734	19042	2		
J5	CONNECTOR,RECEPTACLE,CARD-EDGE	352310	89536	353210	1		
MP1	CABLE TIE,4 INCH (NOT SHOWN)	172080	06383	SST-1M	1		
MP2	CASE,DOU	458323	89536	458323	1		
MP3	CONNECTOR,BACKSHELL	357020	89536	357020	1		
	DOU PCB ASSEMBLY ,FIGURE 602-3 (SHEET 2 OF 2)	ORDER	NEXT	HIGHER LEVEL	1		
H3	NUT,HEX 4-40	110635	73734	8003NP	1		
H4	SCREW,PHP,4-40 X 5/16	152116	73734	19024	1		
H5	WASHER,FLAT #4 PLATED	195909	73734	97405	1		
H6	WASHER,INT LOCK #4	110403	73734	99402	1		
MP4	CABLE CLAMP,3/16	101345	95987	3/16-3NA	1		
MP5	TERMINAL, CONN POST	376574	00779	3-87022-1	18		
MP6	COVER,CONNECTOR	450015	89536	450015	1		

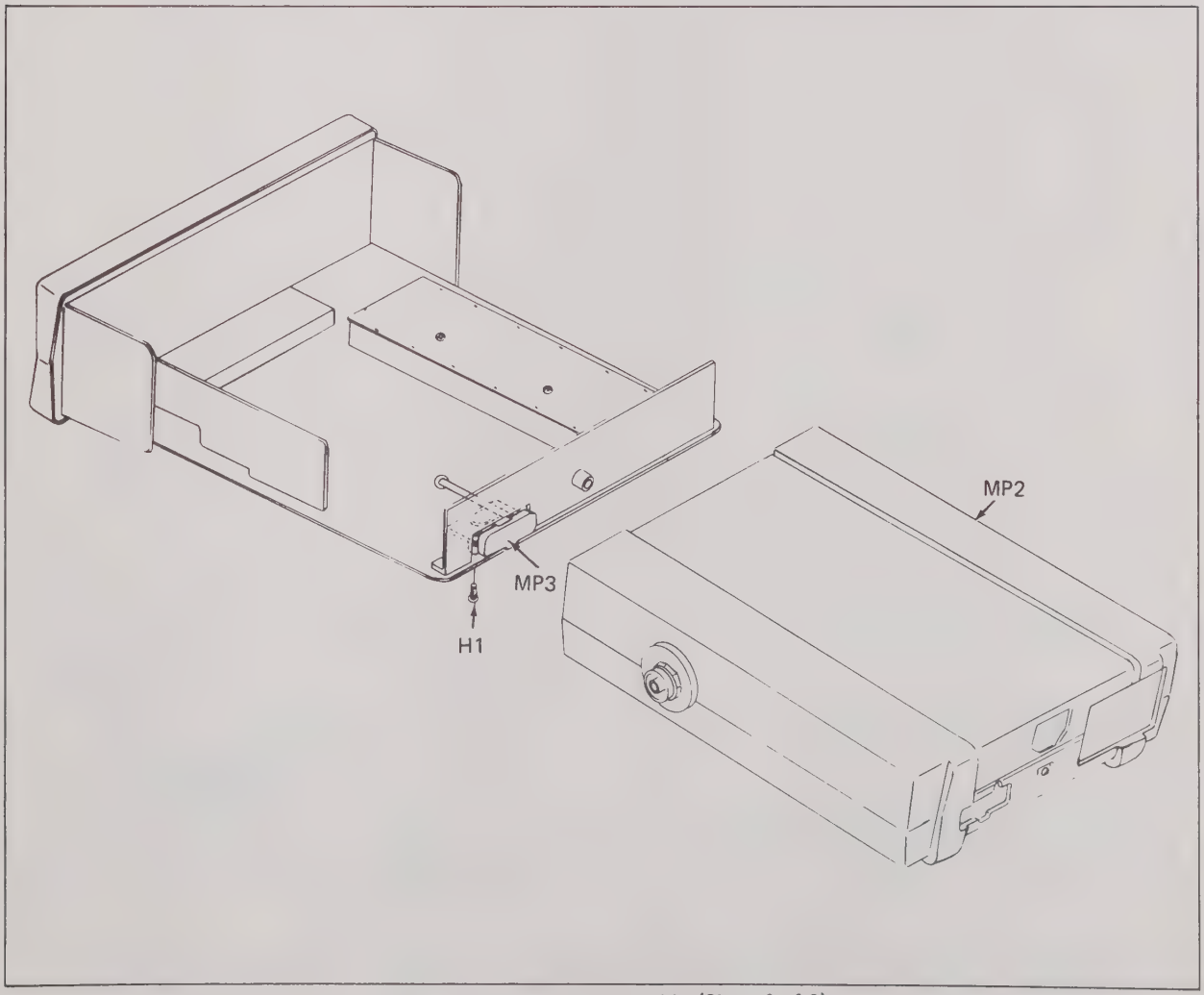

Figure 602-3. DOU Assembly (Sheet 1 of 2)

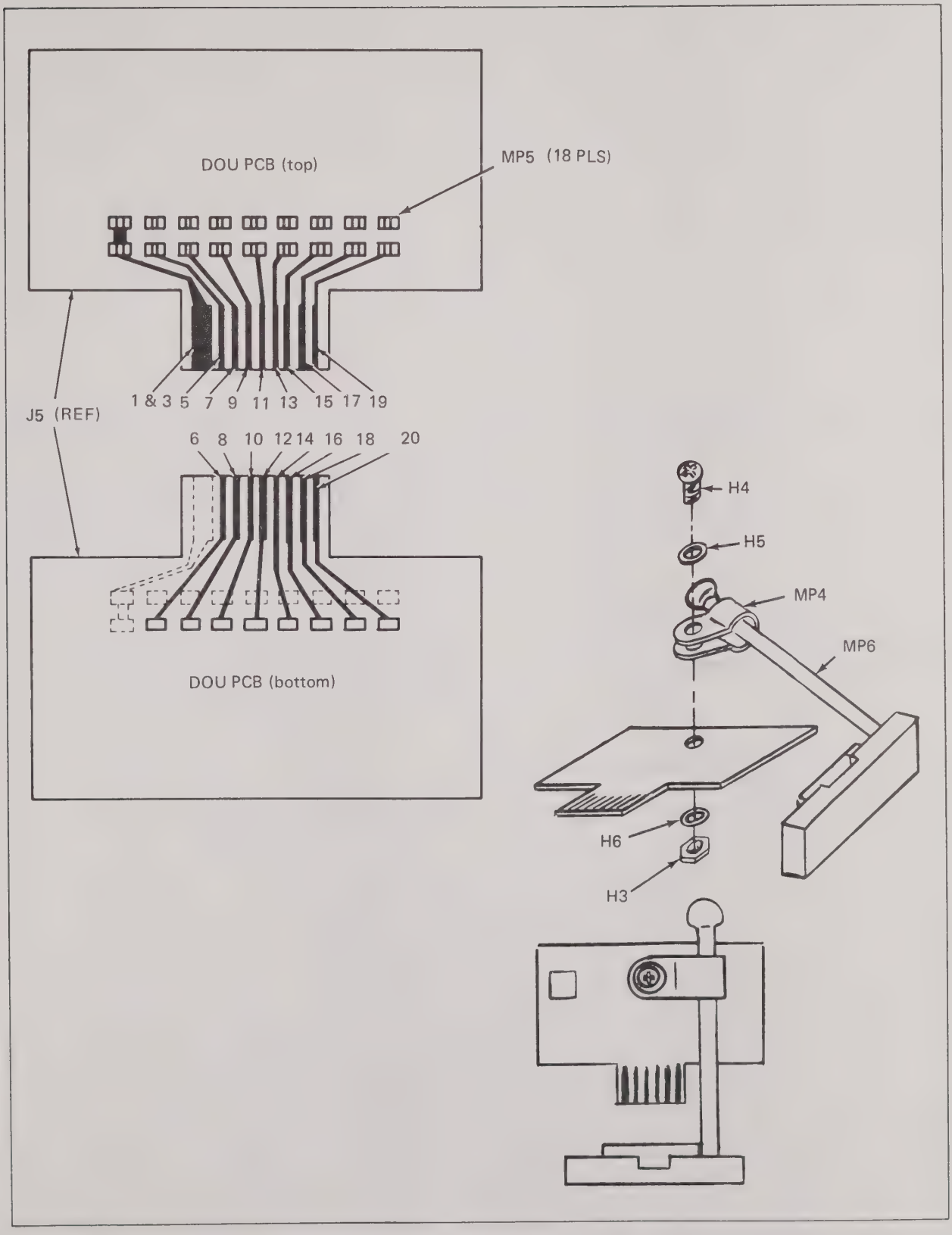

Figure 602-3. DOU Assembly Option –02 (Sheet 2 of 2)

Option -03
TCXO

603-1. INTRODUCTION

603-2. Option —03 is a temperature compensated crystal oscillator (TCXO) which exhibits superior stability than the standard Y1 by using a neutralization circuit. The effects of the neutralization circuit on the crystals center frequency is shown in Figure 603-1. The resultant center frequency deviation (solid line) is held to a minimum over the designed temperature range. Within the desired temperature range the —03 affords a very stable output frequency as well as instantaneous warmup and low power consumption. However, if the temperature limits are exceeded, the crystal's stability will no longer be valid (See Section 1).

603-3. CALIBRATION

1. Allow the counter to operate for at least 30 minutes to stabilize the internal temperature.

2. Select the channel A frequency function, at 0.1 Hz resolution.

3. Connect the 10 MHz reference frequency to the channel A input.

4. Using a non-conductive screwdriver, adjust the TCXO through the rear panel. See component and test point location drawing in Section 4, to obtain a reading of overflow 000.000 ± 10 digits.

603-4. LIST OF REPLACEABLE PARTS

603-5. The —03 TCXO is a completely sealed unit, containing no replaceable parts (See Figure 603-2).

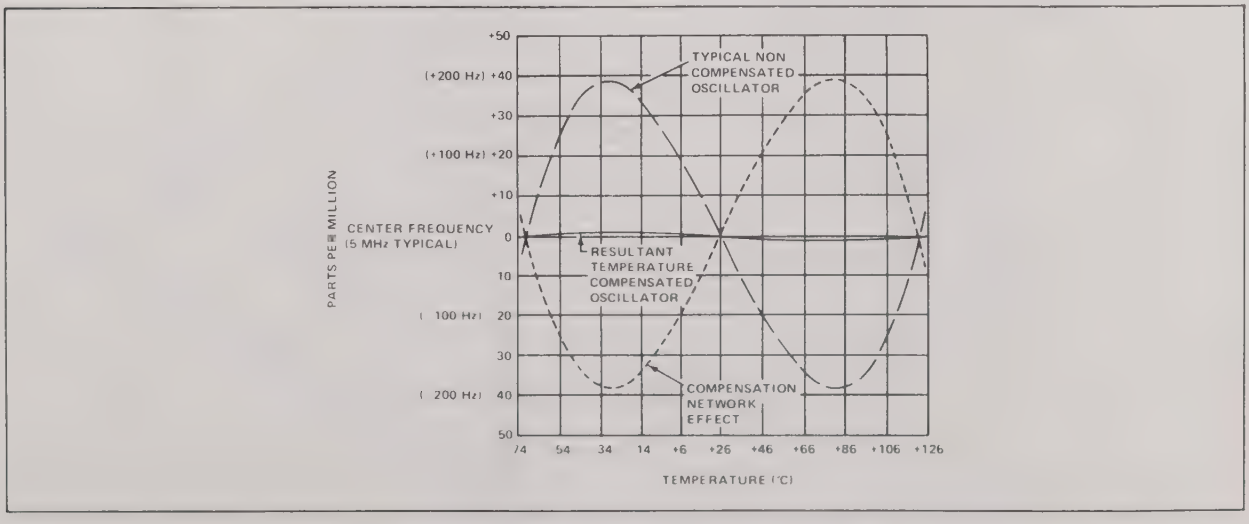

Figure 603-1. Temperature/Frequency Deviation

Table 603-1. –03/–04 TCXO Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-04	SUPERIOR TCXO, FIGURE 603-2	ORDER	MODEL	1910A-04 OR 1911A-04	1		
-03	TCXO, FIGURE 603-2	ORDER	MODEL	1910A-03 OR 1911A-03	1		

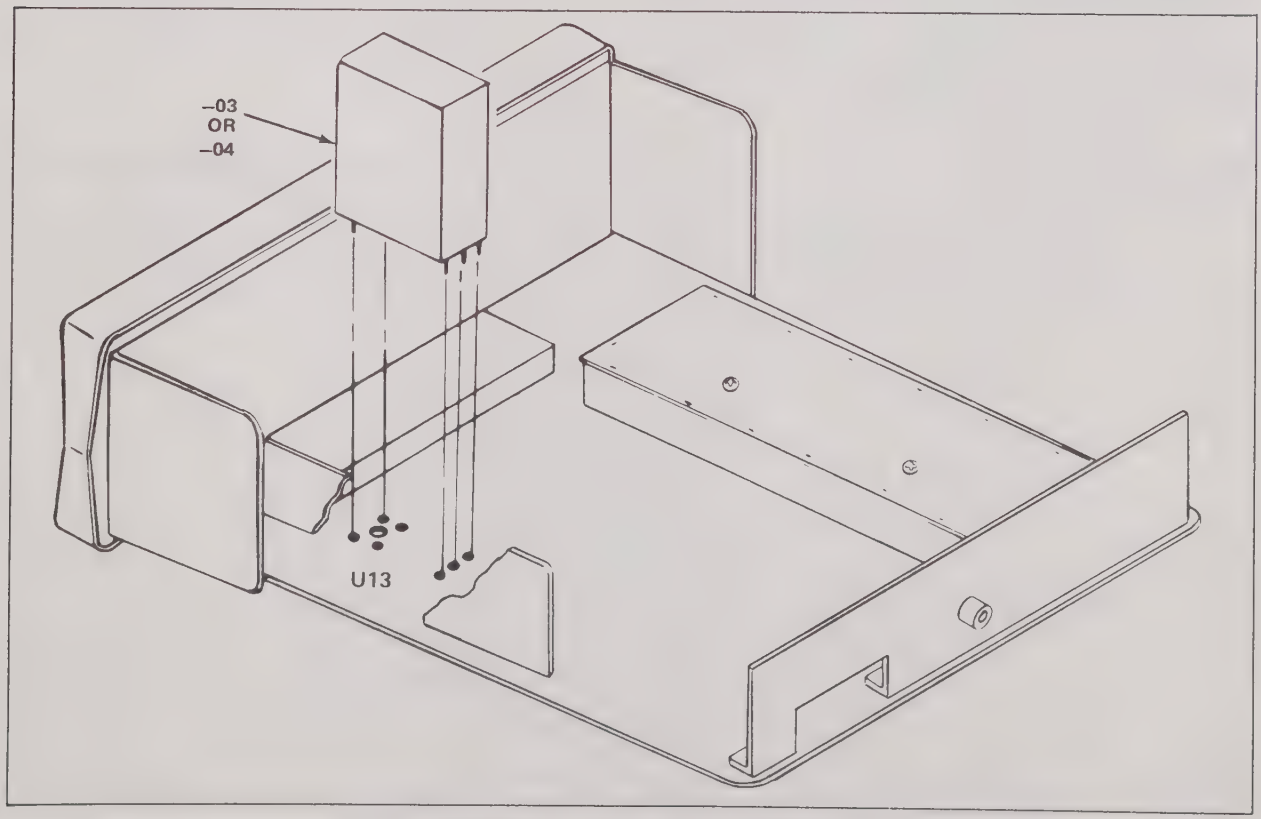

Figure 603-2. –03/–04 TCXO Assembly

Option -04
TCXO (Superior)

604-1. INTRODUCTION

604-2. Option —04 is also a temperature compensated crystal oscillator which used the same neutralization scheme as the —03 Option (See Figure 603-1). However, because of tighter specifications, it is able to reduce its total deviation from the standard 10 MHz to approximately ¼ of the —03's deviation, 0.5 ppm/month.

604-3. CALIBRATION

1. Allow the counter to operate for at least 3 hours to stabilize internal temperature.
2. Select the channel A frequency function at 0.1 Hz resolution.
3. Connect the 10 MHz reference frequency to the channel A input.
4. Using a non-conductive screwdriver adjust the TCXO through the rear panel, see component and test point location drawing in Section 4, to obtain a reading of 000.0000 ± 3 digits.

604-4. LIST OF REPLACEABLE PARTS

604-5. The —04 TCXO is a completely sealed unit, containing no replaceable parts (See Figure 603-2).

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(-) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

Federal Supply Codes for Manufacturers (cont)

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

Federal Supply Codes for Manufacturers (cont)

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

Federal Supply Codes for Manufacturers (cont)

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts, Div. of
Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

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3322 S. Memorial Parkway
Suite 96
Huntsville, AL 35801
(205) 881-6220

AZ, Tempe
John Fluke Mfg. Co., Inc.
2125 S. 48th Street
Suite 104
Tempe, AZ 85282
(602) 967-8724

Tucson
(602) 790-9881

CA, Los Angeles
John Fluke Mfg. Co., Inc.
20902 South Bonita St.
Carson, CA 90746
(213) 538-3900
or (714) 761-2449

San Diego
John Fluke Mfg. Co., Inc.
9601 Aero Drive, Suite 290
San Diego, CA 92123
(714) 226-1254

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John Fluke Mfg. Co., Inc.
2300 Walsh Ave., Bldg. K
Santa Clara, CA 95051
(408) 727-0513

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John Fluke Mfg. Co., Inc.
15445 Red Hill Ave., Suite F
Tustin, CA 92680
(714) 838-8863

CO, Denver
John Fluke Mfg. Co., Inc.
1980 South Quebec St. #4
Denver, CO 80231
(303) 750-1222

CT, Hartford
John Fluke Mfg. Co., Inc.
Glen Locken East
41-C New London Turnpike
Glastonbury, CT 06033
(203) 659-3541

FL, Orlando
John Fluke Mfg. Co.,Inc.
940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

GA, Atlanta
John Fluke Mfg. Co., Inc.
2700 Delk Rd., Suite 250
Marietta, GA 30067
(404) 953-4747

HI, Honolulu
EMC Corporation
2979 Ualena St.
Honolulu, HI 96819
(808) 836-1138

IA, Iowa City
(319) 354-2811

IL, Chicago
John Fluke Mfg. Co., Inc.
3740 Industrial Ave.
Rolling Meadows, IL 60008
(312) 398-0850

IN, Indianapolis
John Fluke Mfg. Co., Inc.
877 Purdue
Suite 101
Indianapolis, IN 46268
(317) 875-7870

KS, Kansas City
John Fluke Mfg. Co., Inc.
4550 W. 109th St., Suite 130
Shawnee Mission, KA 66211
(913) 381-9800

LA, New Orleans
(504) 455-0814

MA, Burlington
John Fluke Mfg. Co., Inc.
25 "B" Street
Burlington MA 01803
(617) 273-4674

MD, Baltimore
(301) 792-7060

Rockville
John Fluke Mfg. Co., Inc.
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

MI, Detroit
John Fluke Mfg. Co., Inc.
13955 Farmington Rd.
Livonia, MI 48154
(313) 522-9140

MN, Bloomington
John Fluke Mfg. Co., Inc.
1801 E. 79th St., Suite 9
Bloomington, MN 55420
(612) 854-5526

MO, St. Louis
John Fluke Mfg. Co., Inc.
2029 Woodland Parkway
Suite 105
St. Louis, MO 63141
(314) 993-3805

NC, Greensboro
John Fluke Mfg. Co., Inc.
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

NJ, Paramus
John Fluke Mfg. Co., Inc.
P.O. Box 930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

NM, Albuquerque
John Fluke Mfg. Co., Inc.
1108 Alvarado Drive N.E.
Albuquerque, NM 87110
(505) 881-3550

NY, Rochester
John Fluke Mfg. Co., Inc.
4515 Culver Road
Rochester, NY 14622
(716) 323-1400

OH, Cleveland
John Fluke Mfg. Co., Inc.
7830 Freeway Circle
Middleburg Heights, OH 44130
(216) 234-4540

Columbus
(614) 889-5715

Dayton
John Fluke Mfg. Co., Inc.
4756 Fishburg Rd.
Dayton, OH 45424
(513) 233-2238

OR, Portland
John Fluke Mfg. Co., Inc.
18360 S.W. Springfield Lane
Aloha, OR 97007
(503) 642-1342

PA, Philadelphia
John Fluke Mfg. Co., Inc.
1010 West 8th Ave., Suite H
King of Prussia, PA 19406
(215) 265-4040

Pittsburgh
(412) 261-5171

TX, Austin
John Fluke Mfg. Co., Inc.
Creek Gardens, Suite 103
8705 Shoal Creek Blvd.
Austin, TX 78758
(512) 459-3344

Dallas
John Fluke Mfg. Co., Inc.
14400 Midway Road
Dallas, TX 75234
(214) 233-9990

Houston
John Fluke Mfg. Co., Inc.
4240 Blue Bonnet Dr.
Stafford, TX 77477
(713) 491-5995

San Antonio
John Fluke Mfg. Co., Inc.
10417 Gulfdale
San Antonio, TX 78216
(512) 340-2621

UT, Salt Lake City
John Fluke Mfg. Co., Inc.
5226 So. 300 West, Suite #2
Salt Lake City, UT 84107
(801) 268-9331

WA, Seattle
John Fluke Mfg. Co., Inc.
5020 148th Ave. N.E.
Suite #110
Redmond, WA 98052
(206) 881-6966

Service Center Areas

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CO, Denver (303) 750-1228
FL, Orlando (305) 896-2296
IL, Chicago (312) 398-5800
MA, Burlington (617) 273-4678
MD, Rockville (301) 770-1576
NJ, Paramus (201) 262-9550
TX, Dallas (214) 233-9945
WA, Everett (206) 356-5560

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Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcn configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual with an X.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

Table 7A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																						
			–	A	B	C	D	E	F	G	H	J	K	L	M	N	P	D-1							
A1	Main PCB (115, 230V)	443366					1	3	7	X								2							
A1	Main PCB (100V)	456954					1	3	7	X								2							
A1	Main PCB –01	443523					1	3	7	X								2							
A1A2	Display PCB	443358			X																				
A1A3	Prescaler PCB	443341					4	5	X																
A2	Inverter PCB	443333			X																				
A3	AC PCB (115V, 58-62 Hz)	456251			6	X																			
A3	AC PCB (230V, 48-52 Hz)	459362			6	X																			
A3	AC PCB (100V, 48-52 Hz)	459370		6	X																				
A3	AC PCB (100V, 58-62 Hz)	463307	6	X																					

X = The PCB revision levels documented in this manual.
▒ = These revision letters were never used in the instrument.
– = No revision letter on the PCB.

CHANGE #1–11131

Make indicated changes to Main PCB parts list.

Delete following items:

U15 P/N 402610, R51 P/N 348920, R52 P/N 348839

Add following items:

R18 P/N 348821

Modify following items:

R20 10k pot P/N 309674, to R20 1.8k P/N 441444.
R39 10k P/N 348839, to R39 100k P/N 348920.
R38 1k P/N 343426, to R38 10k P/N 348839.
R17 22k P/N 348870, to R17 4.7k P/N 348821.
C32 0.01 uF P/N 149153 to C32 10 uF P/N 193623.

MAKE INDICATED CHANGES TO TEXT, WHERE SPECIFIED.

Delete following items:

Paragraph 4-24.

Add following items:

Paragraph 4-24, below.

23. Trigger Level Adjustment (Channel A)

24. The trigger level adjustments should be performed whenever repairs have been made to the input section the counter. Perform the trigger level adjustment as follows:

1. Remove the instrument from it's case.

2. Energize the counter (refer to #1 warning under general maintenance of Section 4) connect the high frequency generator and an RF millivoltmeter via a T-connector terminated into 50Ω to the channel A input.

3. Set the front panel trigger level control to the preset position.

4. Set the generator to 75 mV output level at about 100 MHz. Note the display reading as a reference.

5. Reduce the input level until the display becomes unstable and then try to adjust R11 (internal trigger level, see Figure 4-1) for the reference reading as noted in step 4.

6. Repeat step 4 and 5 until no additional sensitivity is possible. The display must remain as noted in step 4, with an input level below 75 mV.

MAKE INDICATED CHANGES TO ALL SCHEMATICS, DIAGRAMS AND FIGURES AS FOLLOWS:

Delete following items from Figures: 5-2, 601-2, 8-1 and 8-2 (sheet 2 & 3)

U15, R51, R20 and its ground, R52, ground from C28 and +5V from R38.

Add following items to Figures: 5-2, 601-2, 8-1 and if applicable 8-2 (sheet 2 & 3).

HYST line, see Figure 1
R20 1.2k, see Figure 2
R18 4.7k, see Figure 2
+5V to C28, see Figure 3
Ground to R38 10k, see Figure 3

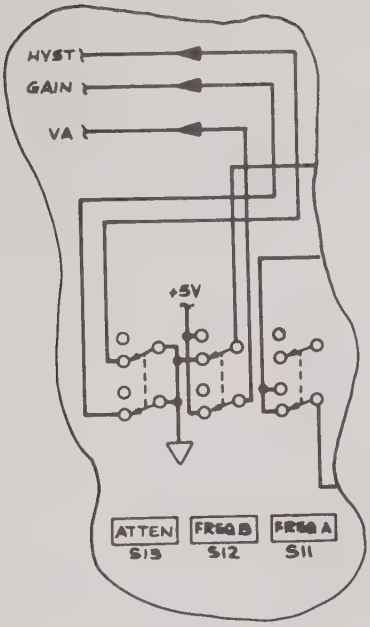


FIGURE –1

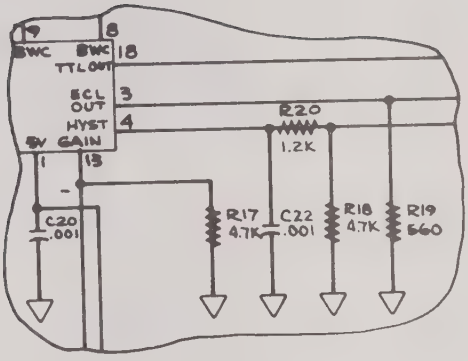


FIGURE –2

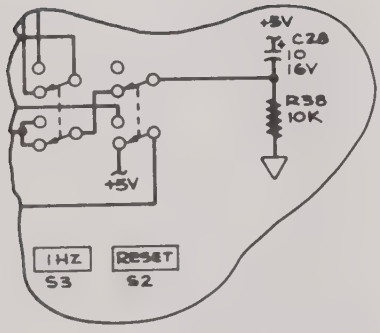


FIGURE –3

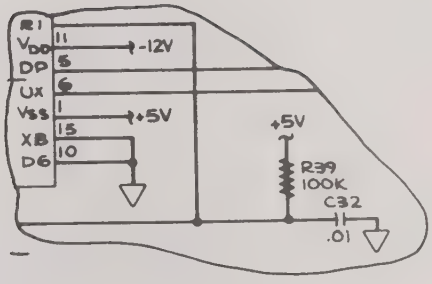


FIGURE –4

Modify following items to Figures: 8-2 (sheet 2 & 3)

R39 10k to R39 100k, see Figure 4
R38 1k to R38 10k, see Figure 3
R17 22k to R17 4.7k, see Figure 2
C32 10 uF to C32 .01 uF, see Figure 4

CHANGE #2

MAKE THE FOLLOWING CHANGES TO PARTS LIST

Delete Following Items:

R39 P/N 348920, R38 P/N 348839, C32 P/N 149153, C28 P/N 193623.

Add Following Items:

In Section 5, page 5-3, add the following to the final

Assembly: A4 Reset PCB Assembly [1]

In Section 6, page 601-2, Table 601-1, Final Assembly,

Add: A4 Reset PCB Assembly (see section 5 Final Assembly) [1]

In Section 5, page 5-18, add the following table and figure:

1910A/1911A Reset PCB Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	RESET PCB ASSEMBLY Figure 5-5	[1]					
C28, C32	Cap, Ta, 10 μF ±20%, 15V	193623	56289	196D106X 0015KA1	2		
R52, R39	Res, dep car, 10k ±5%, 1/4W	348839	80031	CR251-4-5P10KT	2		
R38	Res, dep car, 1k ±5%, 1/4W	343426	80031	CR251-4-5P1KT	1		
U15	IC, linear timer	402610	12040	LM555CN	1		
1 thru 5	Amp pins	376574	00779	3-87022-1	5		

[1] Not procurable at this level

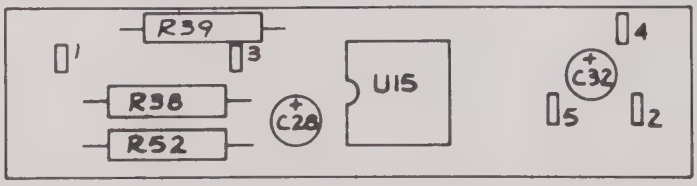


Figure 5-5. Reset PCB Assembly

MAKE INDICATED CHANGES TO TEXT AS FOLLOWS:

Add following items:

3-50. Reset

3-51. The model 1910A/1911A ensures that its display resets to zero after any resolution switch has been actuated by means of a Reset PCB (assembly -A4) shown in Section 5. The Reset PCB uses an IC timer (and associated circuitry) in series with S11 and U6-7 (see schematic diagram Figure 8-11) to lengthen the reset pulse generated by the resolution switches such that the bounce caused by the closing of the resolution switches will not affect the operation of the controller U6.

Place Following Note and Table Between Paragraphs 4-19 and 4-20:

NOTE

Replacement of U1 may necessitate modification of resistor R20 (1.8 kΩ, deposited carbon). To determine if any modification of R20 is necessary refer to "SENSITIVITY CHECK (CHANNEL A)", Section 4 of this manual, and Table –1.

Table –1

SENSITIVITY	R20	
	INSTALLED	NOT INSTALLED
HIGH	Remove R20	Calibrate Instrument
LOW	Calibrate Instrument	Install R20

MAKE INDICATED CHANGES TO ALL SCHEMATICS, DIAGRAMS AND FIGURES AS FOLLOWS:

Delete From Figure 5-2, 601-2, 8-1 and 8-2 (sheet 2 &3)

C28 and its ground, R38 and its +5V, R39 and C32.

Add to Figure 8-2 (sheet 3)

(R52, R39, C28, C32, R38 and U15) see Figure 5.

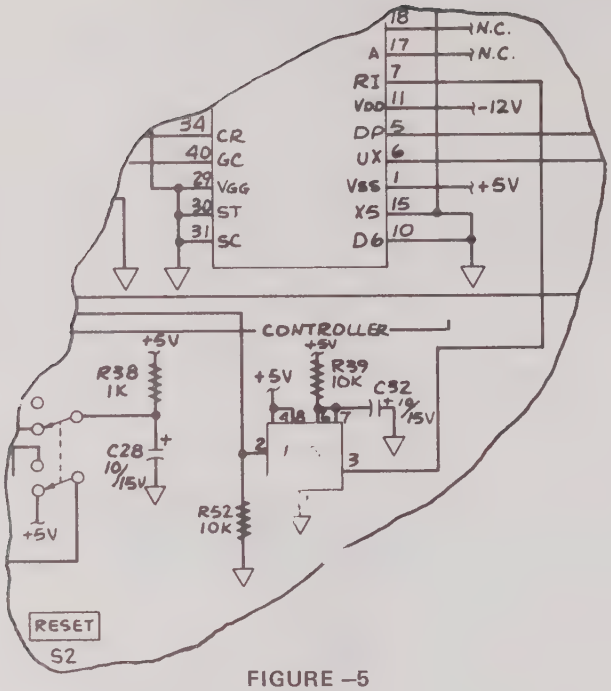


FIGURE –5

CHANGE #3-11432, 11305

MAKE INDICATED CHANGES TO THE FOLLOWING ASSEMBLIES:

Modify the Final Assy Line Version as Follows:

Change U7 from: 473215/55261/LS7031 to: 380238/89536/380238

Modify Tables 5-2 and 601-2, on pages 5-5 to 5-6, 601-4 to 601-6 as Follows:

Change C9 from: Cap, cer, 0.001 uF ±10%, 1 kV/368621/71590/DD-102/1
to: Cap, cer, 0.01 uF, ±20%, 10 kV/149153/56289/CO23B101F103/REF.

Change C27 from: Cap, cer, 0.01 uF, ±20%, 100V/407361/72982/812-A100-W5R-103M/1
to: Cap, cer, 22 pF, ±20%, 10 kV/369157/72982/831-000-C0G0-220/REF

Add: R40/res, dep car, 100k, ±5%, ¼W/348920/80031/CR251-45P100KTS/REF.

Delete: R54/Res, comp, 47 ±5%, ¼W/147892/U121/CB4705/1.

Make the Following Changes to Tables 5-2, and 601-2:

Item MP12. From: Cable Tie/331157/06383/PCT2M to: Holder, Component, Rubber/104794/9815 /2829-115-3.

Modify Figure 8-2 (sheet 1 and 3) pages 8-3 and 8-5 as Indicated by Circled Areas:

CHANGE #4—11245

On Table 5-4, A1A3 250 MHz Prescaler PCB Assembly (1911A Only) make the follwoing changes:

Q301/Xstr, Si, NPN/~~453688~~/419275/01295/~~A5T3571~~/BF357K/2

Q302/Xstr, Si, NPN/~~453688~~/419275/01295/~~A5T3571~~/BF357K/Ref

CHANGE #5—11270

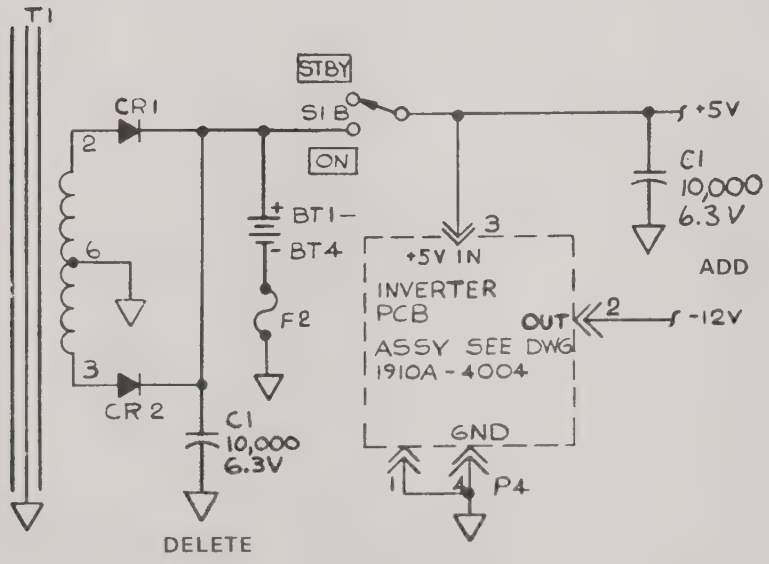
The Rev level of the 250 MHz Prescaler PCB Assembly has been incremented due to a drawing change. This change does not affect the manual or the assembly in any way other than the updating of the Rev level. from E to an F.

CHANGE #6—11166

Change Item CR601 and CR602 from: 407825/12969/UZ8740 to: 453134/12969/UZ8730.

CHANGE #7—11439

On Figure 8-1, A1 Main PCB Assembly make the following changes:



Section 8
Schematic Diagrams

NOTE

Unless otherwise specified all drawings contained in this section pertain to both the nodel 1910A and the 1911A multi-counters.

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FIGURE NO.	TITLE	DRAWING NO.	PAGE
8-1	A1 Main PCB Assembly	1910A/1911A-1001	8-2
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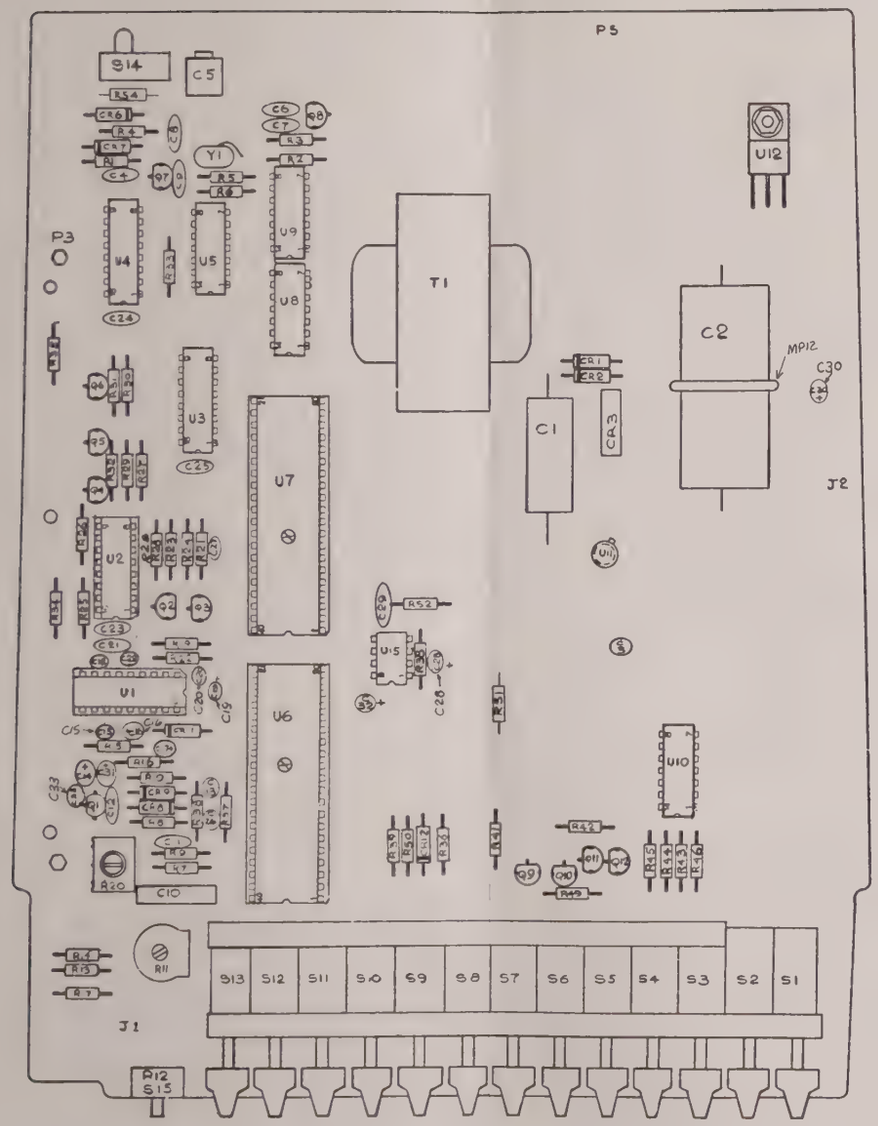
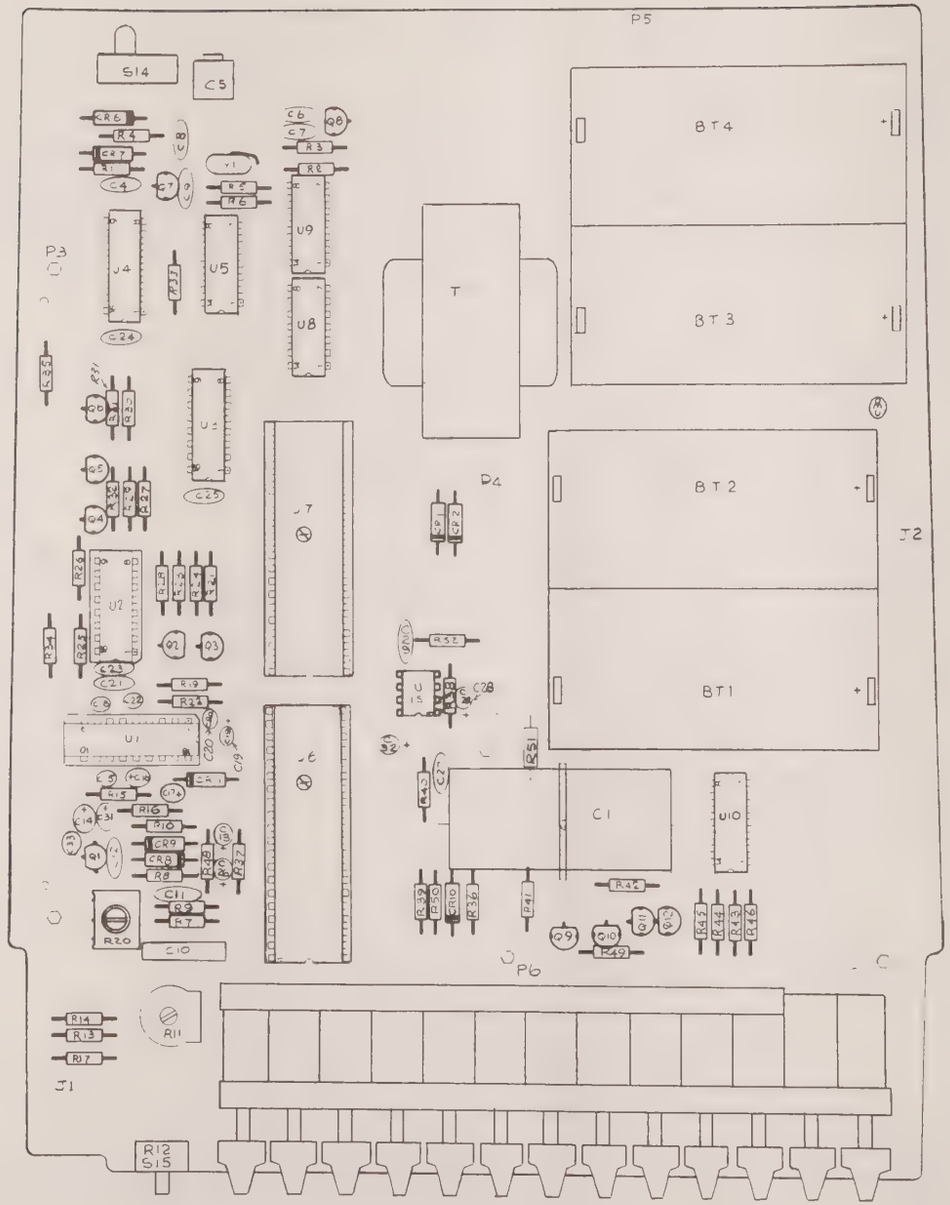
8-3	A1A3 250 MHz Prescaler PCB Assembly (1911A only)	1911A-1003	8-8
8-4	A2 Inverter PCB Assembly (Option –01 only)	1910A/1911A-1004	8-10
8-5	A3 AC PCB Assembly (Option –01 only)	1910A/1911A-1006	8-11
	List of Mnemonics		8-12

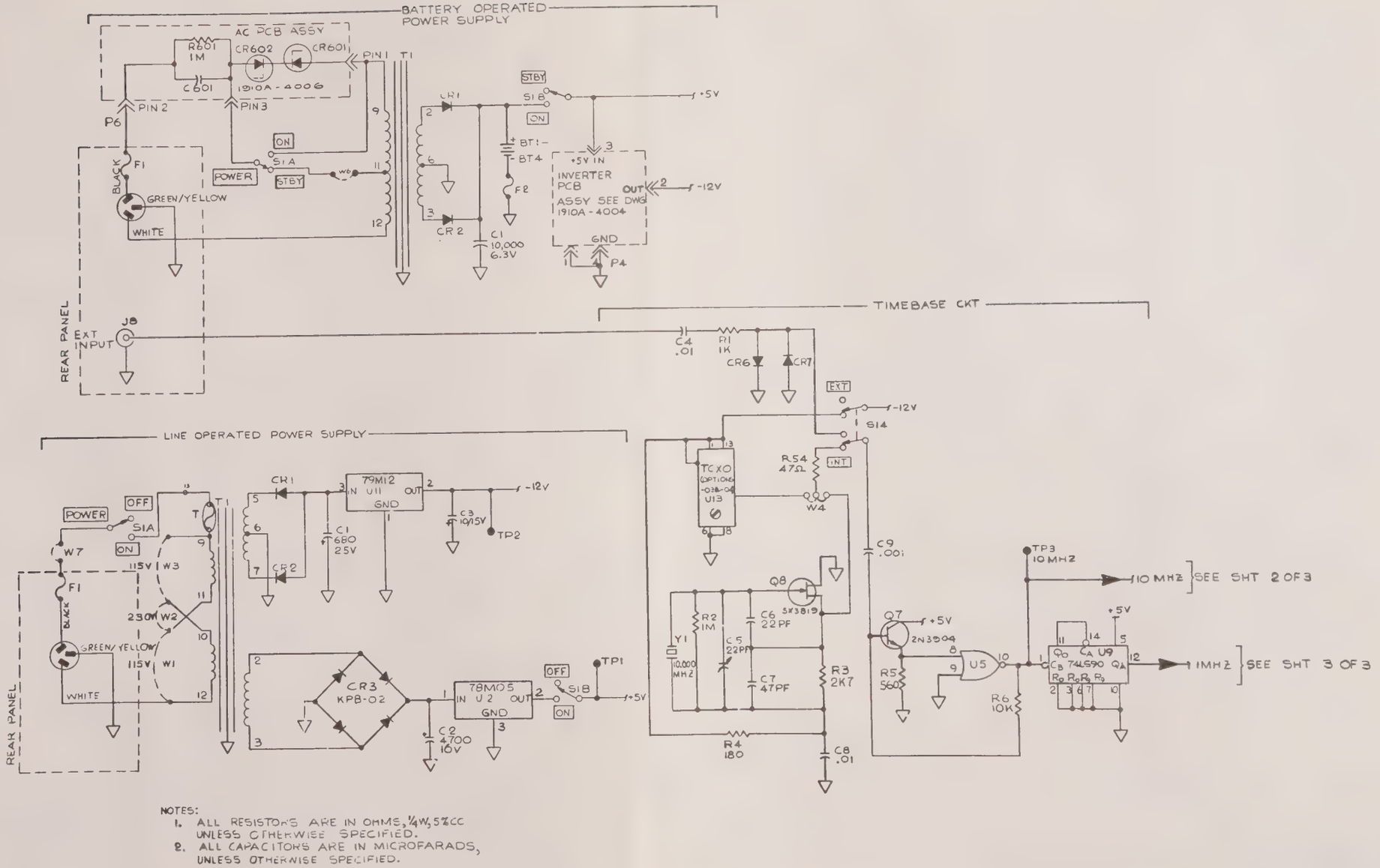


(Line Power 1910A/1911A-1601)



(Battery Power 1910A/1911A-1611)

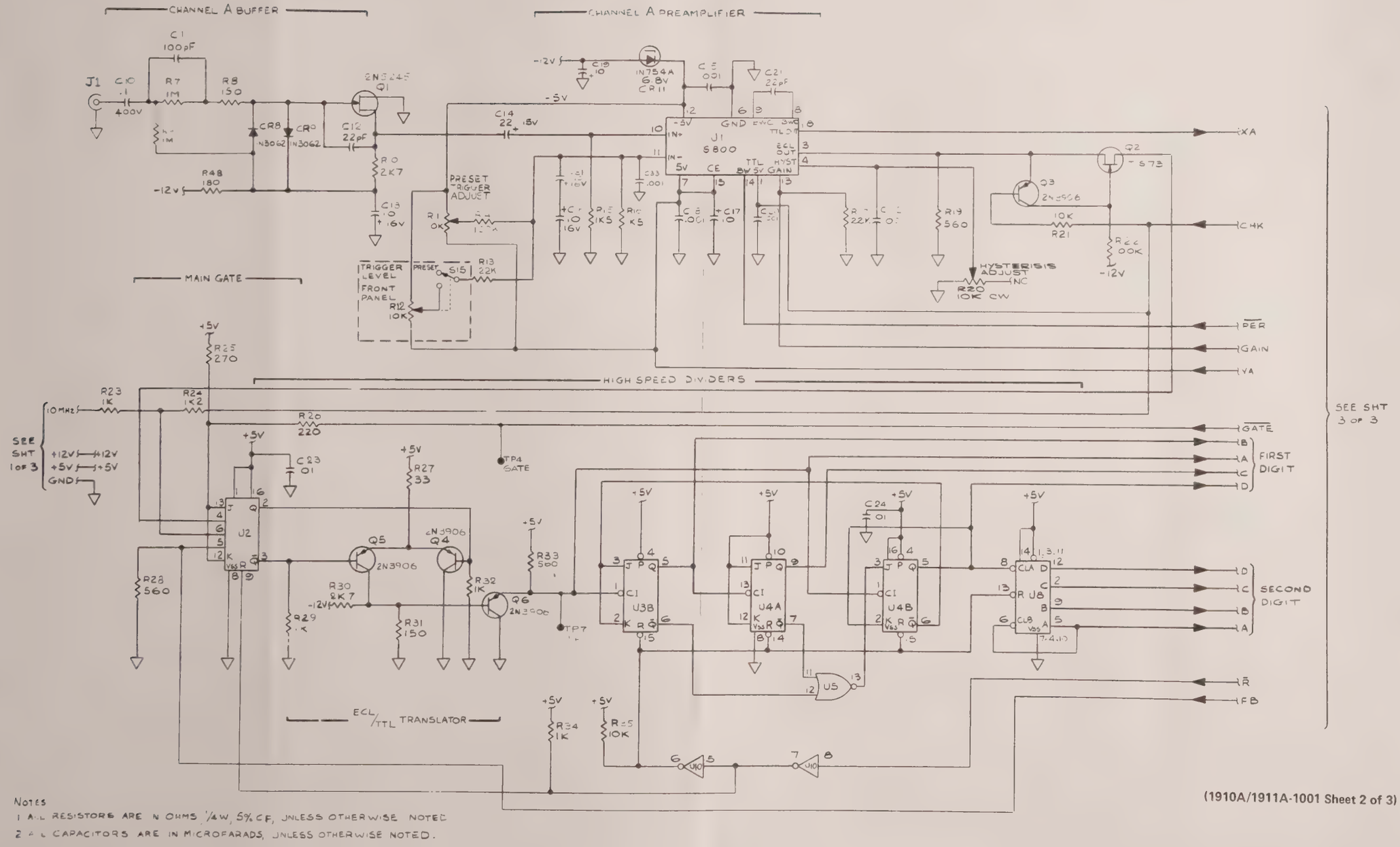
Figure 8-1. A1 Main PCB Assembly



NOTES:
1. ALL RESISTORS ARE IN OHMS, ¼W, 5%CC UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.

(1910A/1911A-1001 Sheet 1 of 3)

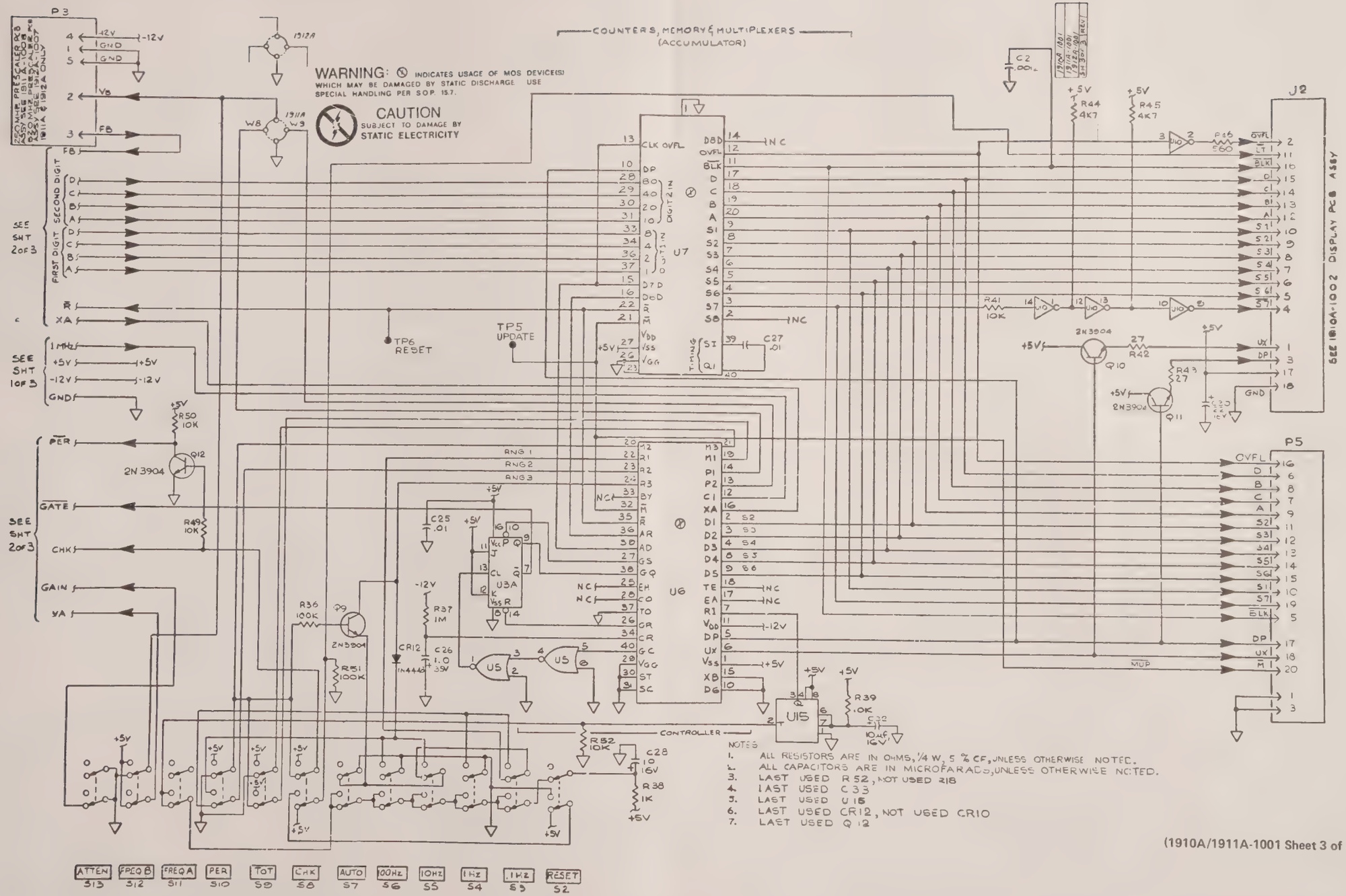
Figure 8-1. A1 Main PCB Assembly (cont)



NOTES
1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% CF, UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE NOTED.

(1910A/1911A-1001 Sheet 2 of 3)

Figure 8-1. A1 Main PCB Assembly (cont)



NOTES

1. ALL RESISTORS ARE IN OHMS, ¼ W, 5 % CF, UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE NOTED.
3. LAST USED R52, NOT USED R18
4. LAST USED C33
5. LAST USED U15
6. LAST USED CR12, NOT USED CR10
7. LAST USED Q12

(1910A/1911A-1001 Sheet 3 of 3)

Figure 8-1. A1 Main PCB Assembly (cont)

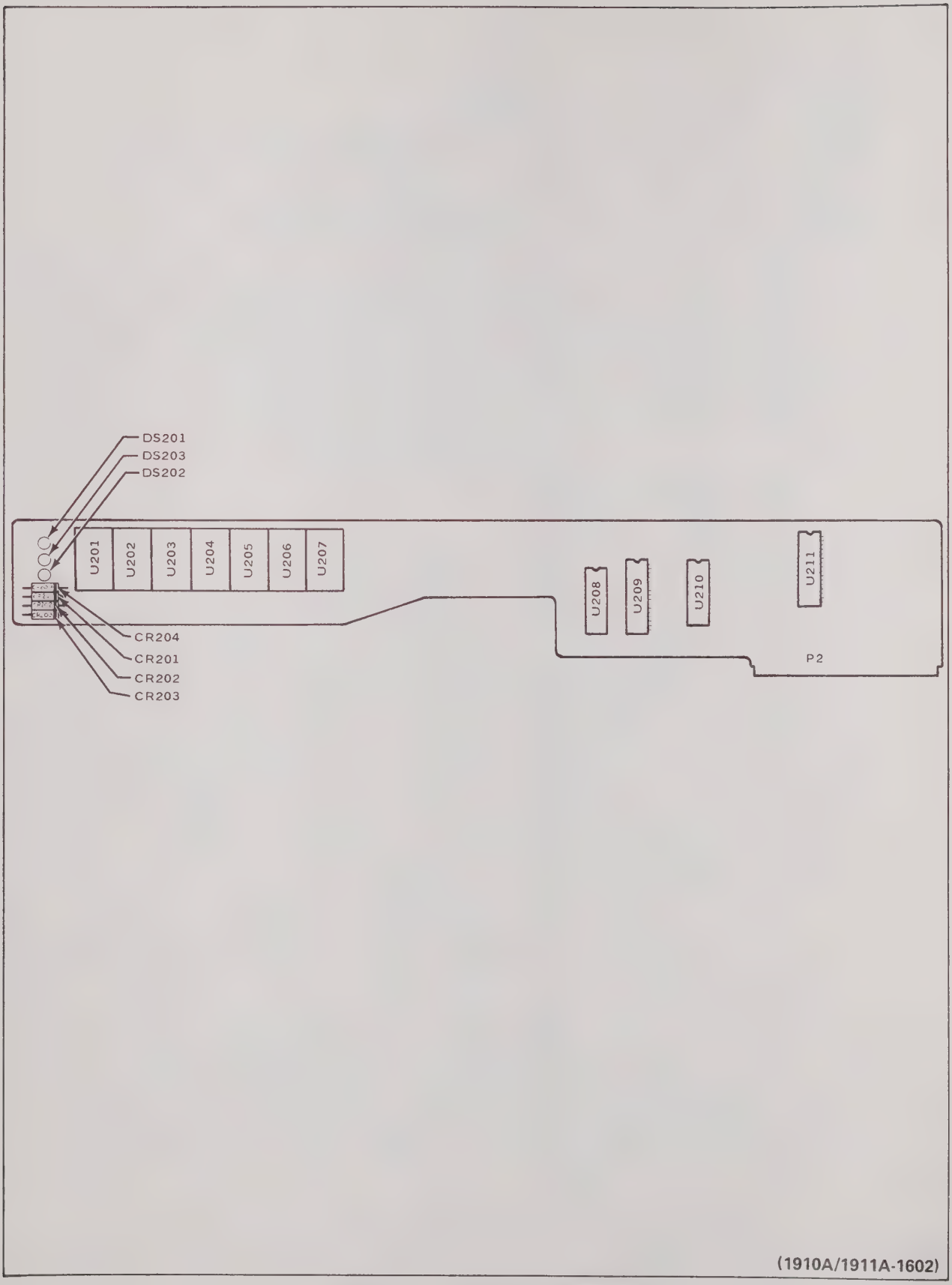


Figure 8-2. A1A2 Display PCB Assembly

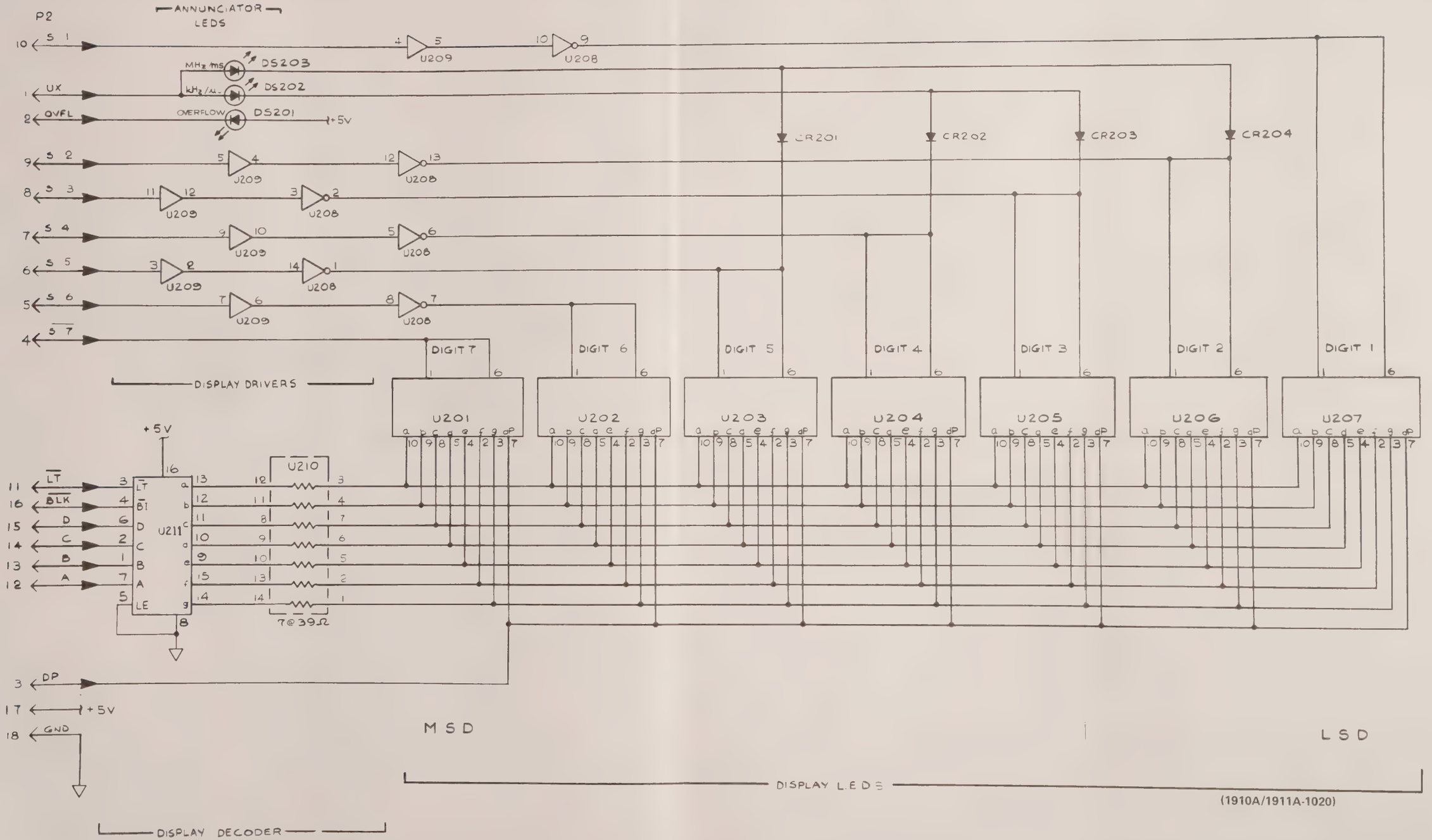
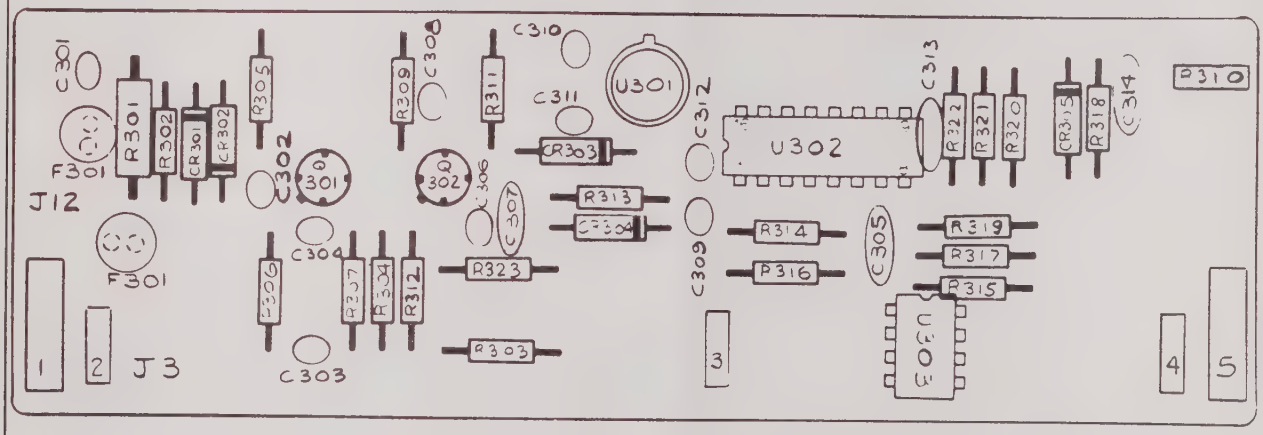


Figure 8-2. A1A2 Display PCB Assembly (cont)



(1911A-1603)

Figure 8-3. A1A3 250 MHz Prescaler PCB Assembly (1911A only)

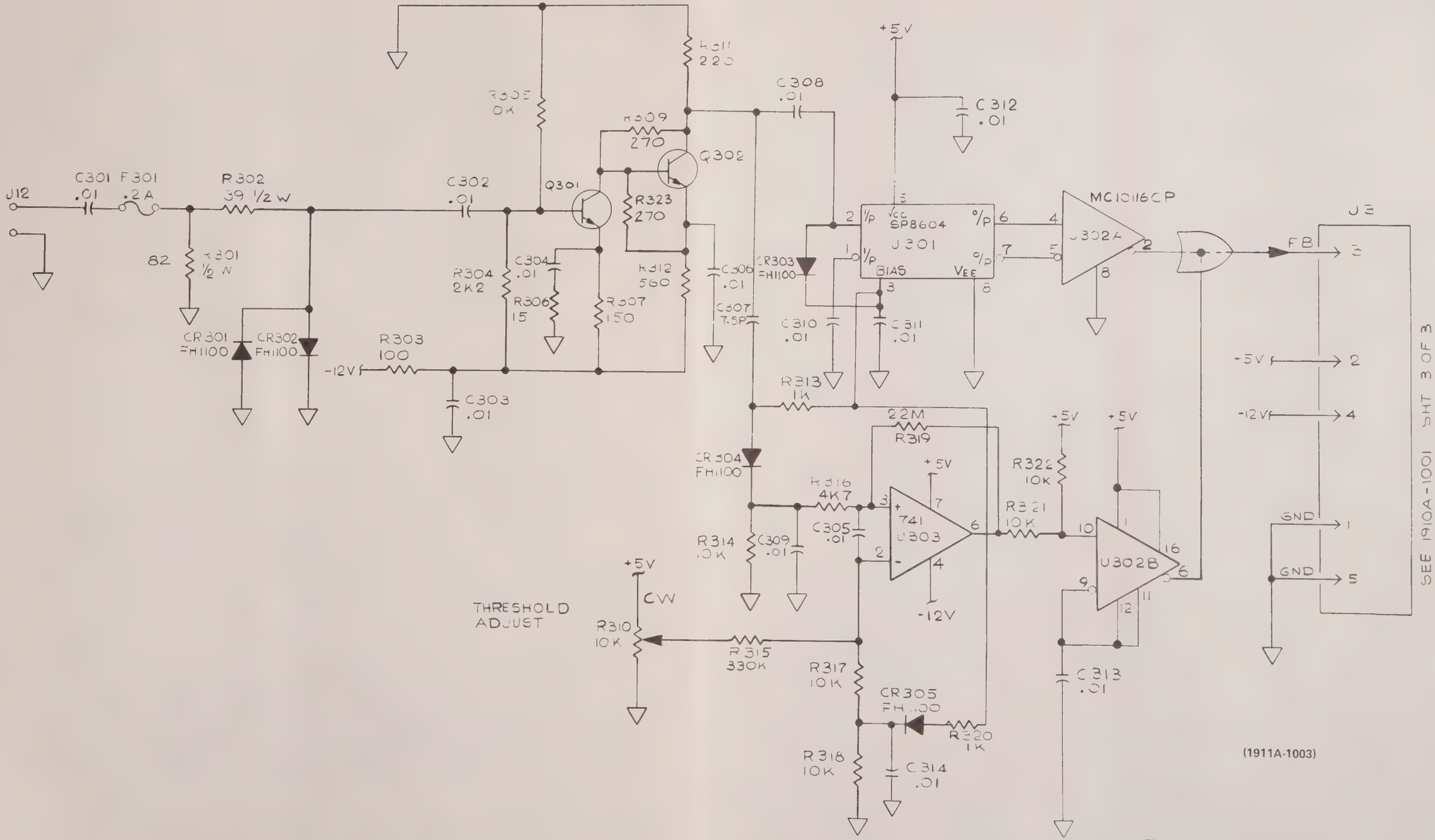
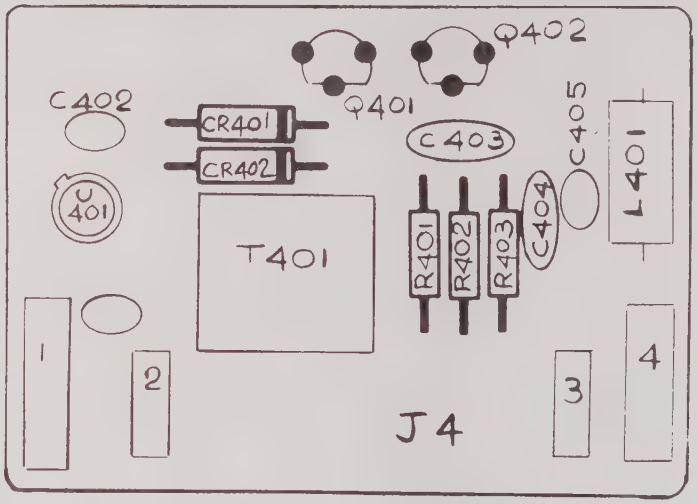
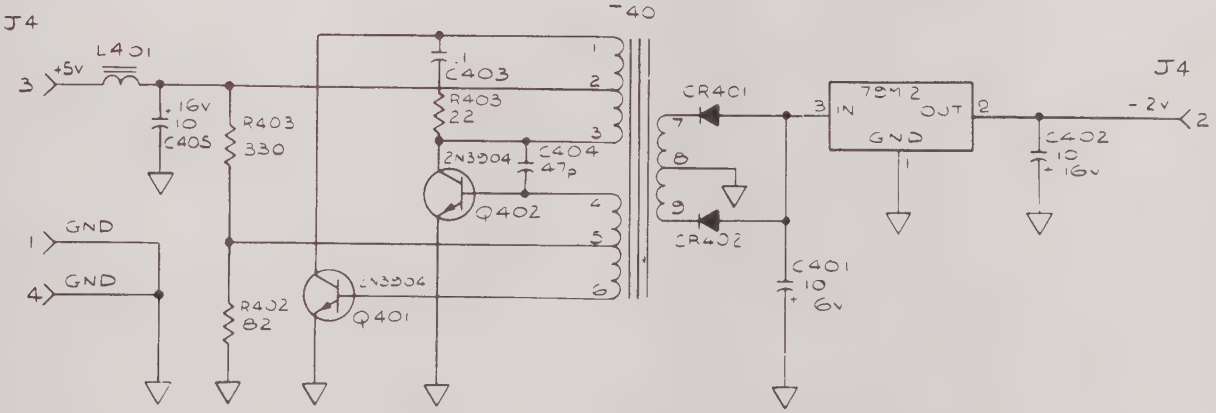


Figure 8-3. A1A3 250 MHz Prescaler PCB Assembly (1911A only) (cont)



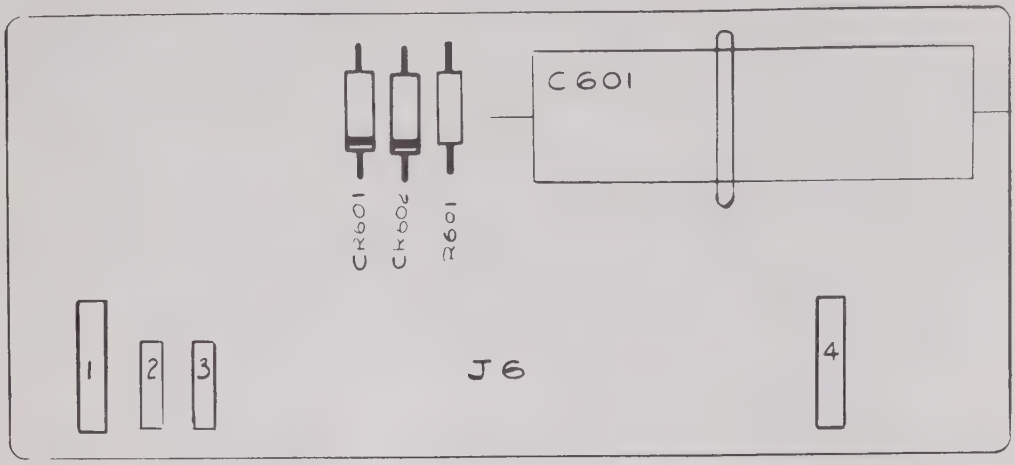
(1910A/1911A-1604)



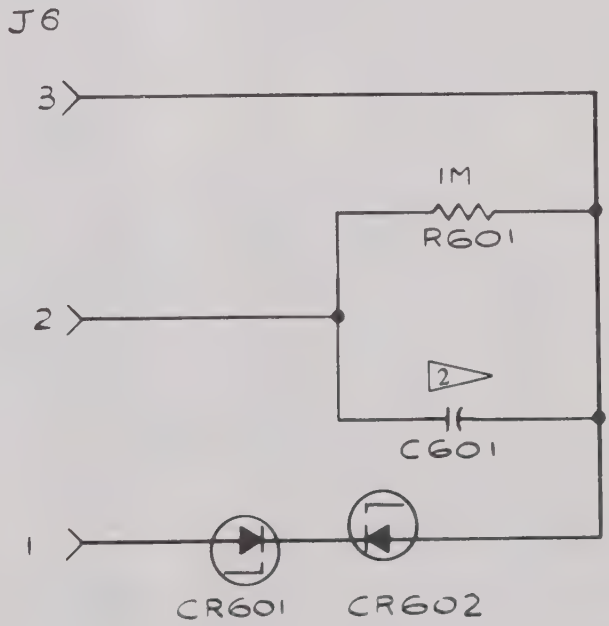
ALL RESISTORS ARE IN OHMS 1/4W 5%, CC UNLESS OTHERWISE STATED
2 ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED.

(1910A/1911A-1004)

Figure 8-4. A2 Inverter PCB Assembly (Option –01 only)



(1910A/1911A-1606)



(1910A/1911A-1006)

2 LINE FREQUENCY Hz	VOLTAGE	C601		DWG NO.
		uF	P/N	
58–62	115/60 Hz	6	393546	1910A/1911A-1006
48–52	100/50 Hz	6.6	394189	1910A/1911A-1012
48–52	230/50 Hz	3.3	380253	1910A/1911A-1013
58–62	100/60 Hz	6	393546	1910A/1911A-1014

Figure 8-5. A3 AC PCB Assembly (Option –01 only)

List of Mnemonics

A = BCD (1)
B = BCD (2)
C = BCD (4)
D = BCD (8)
a =
b =
c =
d = Seven-/-Segment
e = decoded BCD.
f =
g =
ATTEN = Attenuator
AUTO = Autoresolution
BLK = Blanking Rulse to Display, low = time
CHK = Check
DP = Decimal Positioning Pulse
FB = Conditioned Frequency B Signal
GAIN = Gain to U6
$\overline{\text{GATE}}$ = Inverted Gate Pulse
HYST = Hysteresis to U6
$\overline{\text{M}}$ = CMOS Pulse to update memories in Display Section, low = true
M2 = Transition pulse for period mode, blocks ECL level, high = true
$\overline{\text{MUP}}$ = M
OVL = Overflow
PER = Period
$\overline{\text{R}}$ = TTL Pulse to Reset display decode counters low = true
STBY = Standby
$\overline{\text{S1}}$; $\overline{\text{S7}}$ = Negative switch pulse
S8, S9 = Switch pulse
TOT = Totalize
UX = Units annuciation, multiplexed high = true
VA = Chan A, 5V supply
VB = Chan B, 5V supply, high = true
XA = Conditioned Frequency A Signal, from Preamp (used in period)

Application Bulletin

FLUKE

AB-39

Practical Counter Applications

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Introduction

This application bulletin presents a few of the many applications possible with Fluke counters. The applications presented here are for the counters by themselves and in conjunction with other instruments. The general notes in Section 1 are intended as an aid to solving the difficult problem of measuring signals with super-imposed noise.

For more information about these applications or about other possible applications contact your nearest Fluke sales office or call the factory in Seattle at (206) 774-2481.

Section 1
Input Signal Processing

General Notes

All counters contain input signal conditioning circuitry whose function is to accept an analog signal of random shape and level, and convert it to a digital signal that can be measured by the counter. Trouble arises when noise and unwanted signals superimposed on the signal are large enough to be sensed by the input. The result can be false counting and readings that vary over a wide range in a random fashion.

There are many different kinds of noise: Ringing caused by unterminated cables, noise from ground loops, noise inherent in the signal source, and radiated noise or RFI. There are various mechanisms to prevent this noise affecting the counter.

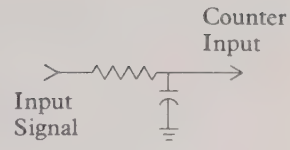
The counter operator can try shielding the cable and the counter to keep RFI out, terminating the cable at the counter to stop signal ringing, breaking grounds to prevent ground loops, filtering the signal to remove the noise, attenuate or reduce the signal level which will tend to reduce the amplitude of noise on the signal.

Attenuation is usually the easiest first choice as many counters have this feature built in, if not, external in-line attenuators, or pads, can be used. Attenuating the signal attenuates superimposed noise at the same time, reducing the noise to a point where the counter will not be affected by it. Filtering the signal is also an effective way to get rid of noise. If the counter does not have an internal filter, an external filter network may be made.

The following is an example that illustrates how to design a simple low pass filter to remove high frequency noise from a signal. (High frequency noise is one of the most common causes of false counting and unstable displays in counters.)

Example: You are measuring a frequency around 800 kHz, and would like to cut-off all frequencies above 1 MHz. Using the schematic in Figure 1 and assuming a 1K series resistor you can calculate the value for the capacitor using the following formula:

$$C = \frac{1}{2\pi fR}$$
$$= \frac{1}{(2)\ (3.14)\ (1x10^{6})\ (1x10^{3})}$$
$$= 1.59 \times 10^{-10}$$
$$= 159 \text{ pf}$$



You would select a capacitor as close to 159 pf ±10% as you can get. When you build the filter, be sure to keep the lead lengths short and the circuit lay-out well grounded, this will keep the noise from "leaking" around the filter.

By keeping the R value at 1K ohm, we can then come up with a handy table of cut-off frequencies in multiples of 1 MHz.

Table 1

f cut-off	R(ohms)	C
1 MHz	1000	159 pf
100 kHz	1000	1590 pf
10 kHz	1000	.0159 μf
1 kHz	1000	.159 μf

APPLICATION 1-1

Using A Voltmeter for Input Signal Processing

For low frequency measurements, a voltmeter with the proper output, and counter may be used together to extend the sensitivity range of the counter and to effectively float the counter input above or below ground.

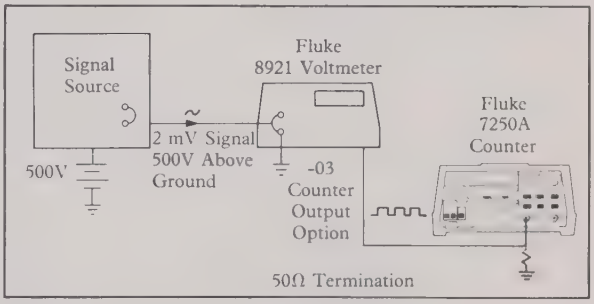


Figure 1

The Fluke 8921A in the example is a 20 MHz RF Voltmeter with a floating input. It can measure signals as small as 2 mV rms and elevated by as much as ±500V with respect to ground.

APPLICATION 1-2

Using A Scope for Input Signal Processing

An oscilloscope and a counter can be used together to make a superior measurement system. In this system the scope is used to condition the signal before it reaches the counter.

The scope can amplify, filter or attenuate the signal. Using a scope with a vertical signal out, the hookup would be as follows.

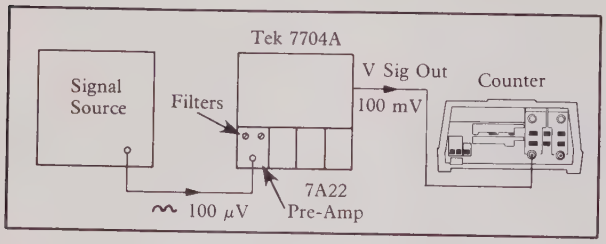


Figure 2.

In the above case, the 100 μV signal, which would normally be too small to be counted, is effectively amplified by the scope.

The 7A22 in the example has switch selectable low and high filters to further condition the signal if necessary.

APPLICATION 1-3

Floating Measurements of Computer Signals Using Battery Option

The battery option is very handy for testing large digital systems since it allows the counter to be connected directly into the circuit at any point without introducing power line ground currents. A X10 oscilloscope probe can be used to minimize capacitive loading in high speed circuits. Personal caution must be taken to avoid dangerous voltages while making floating measurements, as the external metal parts of the counter will assume those voltages.

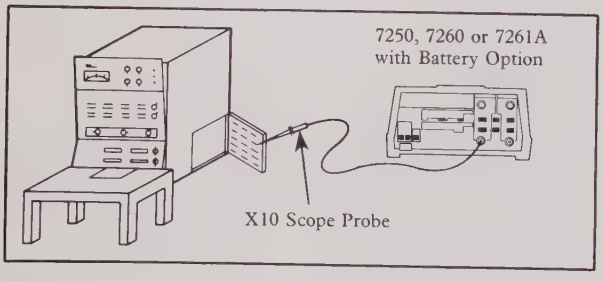


Figure 3.

Section 2
Measuring RF Transmitter Frequencies

Sample and Hold For Measuring CB Transmitter Frequencies

A CB carrier frequency may be measured without tieing up the channel for a lengthy period of time if the counter has a switch selectable external timebase input. See the counter to the frequency function and to the resolution desired. Key on the transmitter and adjust the distance between the antennas until a stable reading is obtained. Switch to the external timebase mode. The counter will immediately stop gating and *hold the reading* until you return the switch to the internal timebase mode. When using batteries with the antenna, we recommend a separate ground connection to prevent noise pickup. This is especially true when using the high impedance 1 MΩ input.

This may also be measured on the 7260A or 7261A by: slide the CONT/TRIG switch to the TRIG mode at the rear of the counter, with the B channel slope selector in the + position. Key the transmitter on and place it the same distance away from the counter, adjust the B trigger control slowly until the reading appears. It will now hold the display when the transmitter is keyed off.

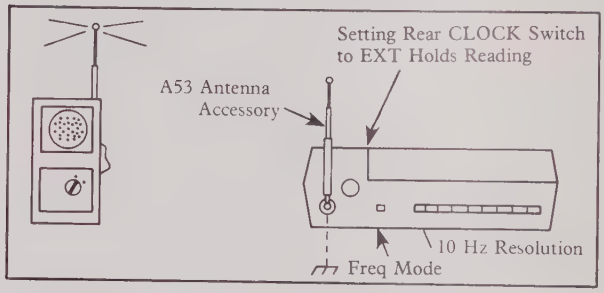


Figure 4.

Section 3
Period Measurements and Low Frequency High Resolution Measurements

APPLICATION 3-1

Using Period Average Mode for High Resolution at Low Frequency

For low frequency signals, the Period Average Mode offers higher resolution and faster display update rate than the frequency mode.

Example: Calibrate the line frequency of a portable power generator.

Using Frequency Mode the best resolution obtainable is 0.1 Hz (three digits) with a display update each 10 seconds. For Period Average Mode a calculator is used to calculate the precise period of 60 Hz. Period = 1/frequency = 16.66666 milliseconds. The generator is then adjusted until the counter display reads 16.66666 ms. Selecting Period Average Mode produces 7 digits of resolution in less than 1 second. Note that both resolution and update rate are substantially better than the frequency mode.

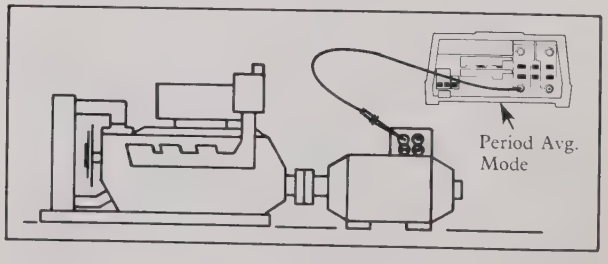


Figure 5.

APPLICATION 3-2

Heterodyne to Increase Resolution

In telecommunications it is common to calibrate signal sources to accuracies of $1x10^{-7}$ or $1x10^{-8}$. You can use a counter with a high stability timebase to do this. But what do you do when the desired accuracy is $1x10^{-10}$? There is a way to do this that will give you .1 MHz resolution and accuracies in the order of 10^{10} to 10^{-11}. Consider the block diagram below.

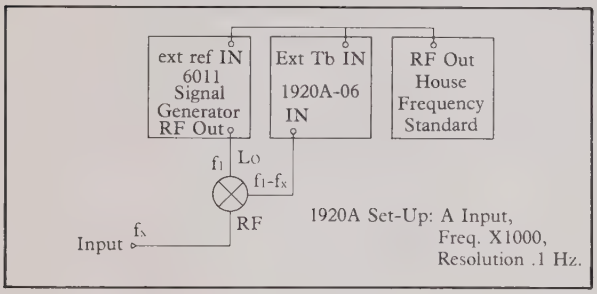


Figure 6.

We see a 6011A signal generator, a 1920A counter with option -06 (resolution multiplier) and, for best possible accuracy, couple both to a primary frequency standard to use as the measurement system timebase.

The principle of the measurement is to mix the input frequency with a reference frequency and then measure the difference frequency. To make sure that we always have a frequency difference, and not a frequency sum, at the mixer output, the reference frequency from the 6011A is set 1 kHz higher than the frequency we want to measure. Using a difference frequency of less than 10 kHz allows us to use the resolution multiplier in the 1920A. Besides giving high resolution in a relatively short gatetime, the resolution multiplier has a second advantage. Its limited bandwidth (10 kHz) attenuates both the sum frequency from the mixer output ($f_1 + f_x$) and much of the system noise. This means that a low pass filter, which is normally required at the mixer output, is not needed here.

If all of the instruments are coupled to the inhouse primary frequency standard, only its accuracy, the noise of the mixer and the accuracy of the resolution multiplier (±2 counts) affect measurement accuracy. When the mixer is used with a sufficiently low noise level (like a ZAD 1H from Minicircuits Labs) and the input signal levels are high enough, the noise of the mixer can be ignored. Total accuracy is less then: ±Accuracy of house standard ±2 Counts.

The limitations of the system are:
- frequency range of the mixer
- min/max input levels to the mixer
- mixer conversion loss
- sensitivity of the counter

Further, the signal levels input to the mixer should be equal to within a few dB.

An experimental system was built up with two 6011A Fluke Signal Generators (one for the known and one for the unknown signal), a 1920A-06, and ZAD 1H mixer with all instruments driven by a Fluke 1953A-10, high stability oven oscillator. The input signals to the mixer were varied between −20 dBm and +10 dBm at frequencies between one and 10 MHz. The error was always within the ±2 count limit. The mixer noise with this or any equivalent mixer is well below threshold and does not contribute to the total accuracy.

APPLICATION 3-3

Calibrating Function Generators Using Period Average

An inexpensive function generator can be calibrated during maintenance or after repair with good accuracy using the period average mode of a counter. Connect the generator to the counter and select the period mode on the counter and the desired resolution. The built in accuracy of the crystal time base will give lab calibration to the generator no matter what price range the function generator falls into.

The function generator can then be used to test other equipment in the repair or maintenance shop.

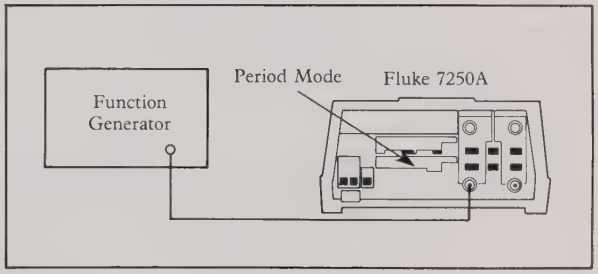


Figure 7.

Section 4
Totalize and A Gated By B Measurements

General Notes

Totalize is the simplest mode of a multifunction counter. In the totalize mode, the main gate is opened manually or by an external control signal. In this mode, the counter's time base is not used. Figure 8 shows the schematic in the totalize mode.

In the A gated by B mode, the A input is totalized during the time the B input is high. This is summarized in the diagram below, while the schematic for the A gated by B mode of the counter is shown in Figure 10.

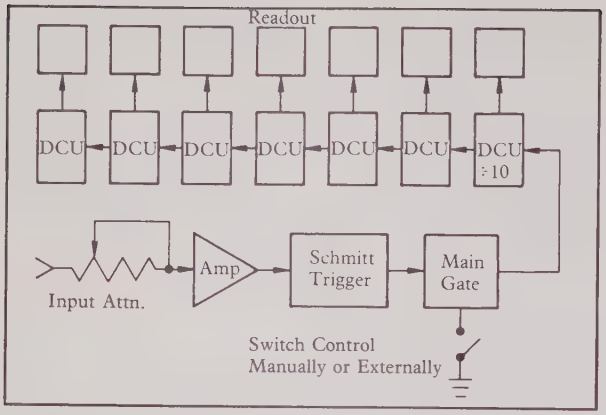


Figure 8. TOTALIZE MODE

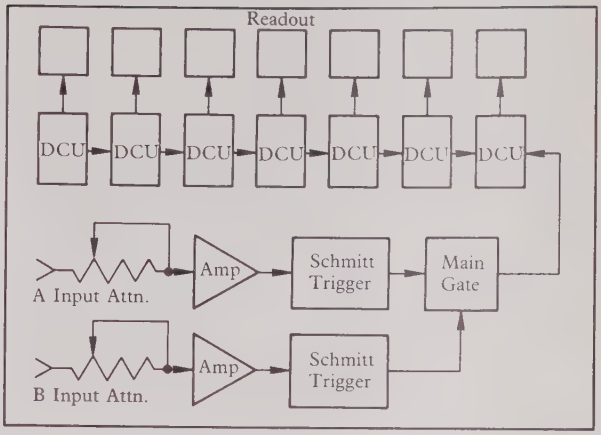


Figure 10. A GATED BY B

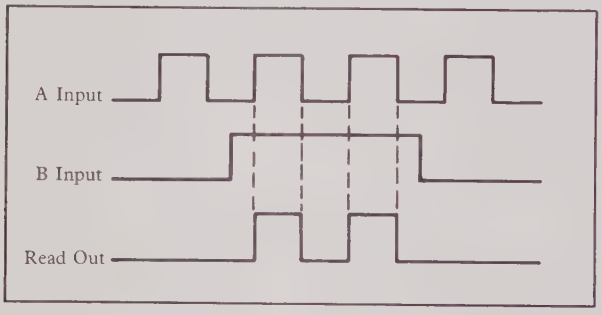


Figure 9. A GATED BY B READOUT

APPLICATION 4-1

Contact Bounce

When a relay or switch closes, its contacts will generally bounce a number of times due to the elasticity of materials used. Bouncing can be detected and the number of bounces counted, with the set-up in the diagram below.

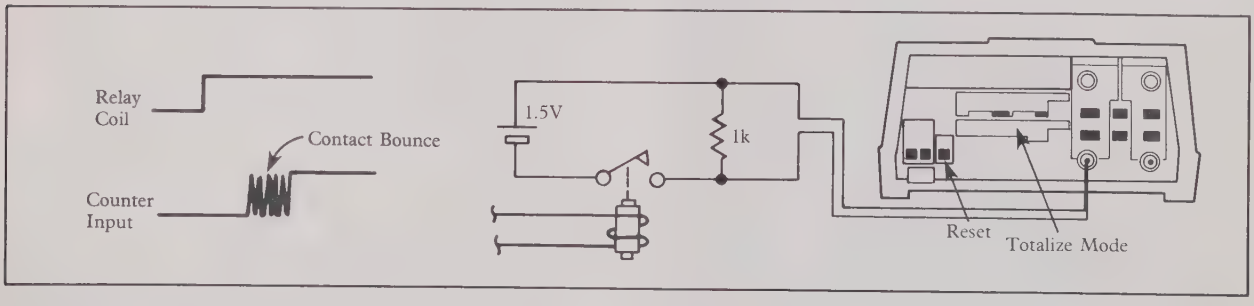


Figure 11.

When the relay (or switch) is closed, each contact bounce will be totalized on the counter.

APPLICATION 4-2

Counting the Number of Pulses in a Burst

When counting the number of pulses in a burst where the signal amplitude is very small or the modulating waveform is not available to trigger the counter, the set-up in Figure 12 is useful.

In this example, the oscilloscope vertical amplifier amplifies the signal amplitude and the B Gate Out signal provides a signal that can be used to control the measurement time of the 1953A in its A gated by B mode.

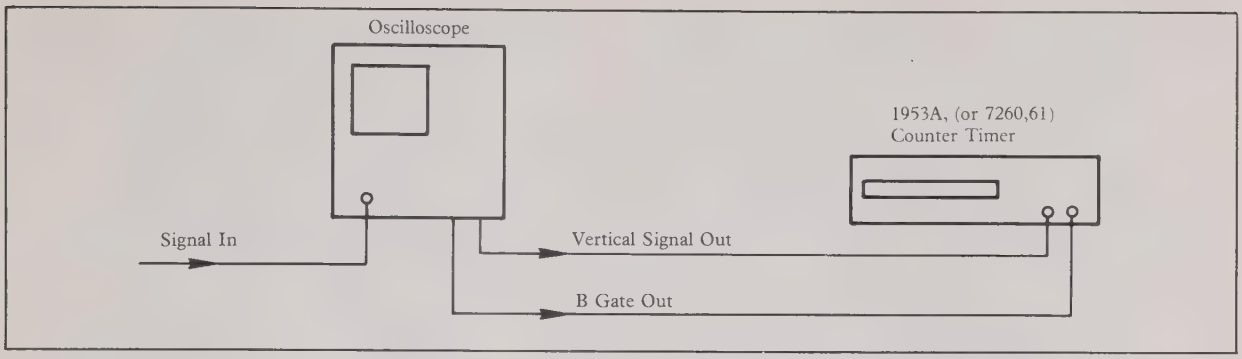


Figure 12.

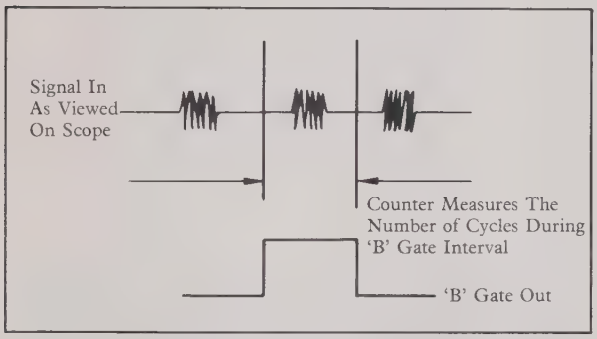


Figure 13.

On an oscilloscope with delayed sweep, the position and duration of the "B Gate Out" pulse may be adjusted by the delayed sweep controls. To make this measurement, the delayed sweep controls are adjusted so that the intensified portion of the sweep exactly brackets one signal burst. In the example in Figure 13, The 1953A, in the 'A gated by B' mode, will totalize the number of cycles in the signal burst over the duration of the 'B gate out' pulse. If the bursts are repetitive and requirement is to totalize the number of pulses in a single burst, set the oscilloscope trigger mode switch to "single sweep". The scope will then put out a single B Gate Out cycle and the 1953A will totalize pulses in only a single burst.

APPLICATION 4-3

Elapsed Time Using Clock Out of 1925A or 1953A

Elapsed time may be measured using the above diagram, with the counter in the totalize mode. At the start of the event the switch is closed by the operator. The counter, which as a 10 MHz timebase, will give a display of 10 000 000 in one second of time, or 1.000 000 seconds. This is 10 ns resolution! If 12 seconds go by, your display will be 10 000 000 x 12 = 120 000 000, and if 60 seconds go by, your display will be 60 x 10 000 000 or 600 000 000.

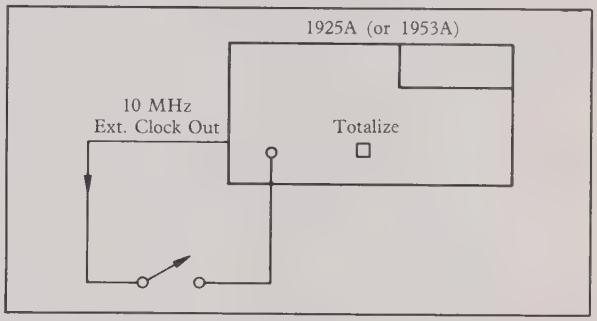


Figure 14.

If you wish to totalize electronically you may use a NAND gate connected in the diagram below.

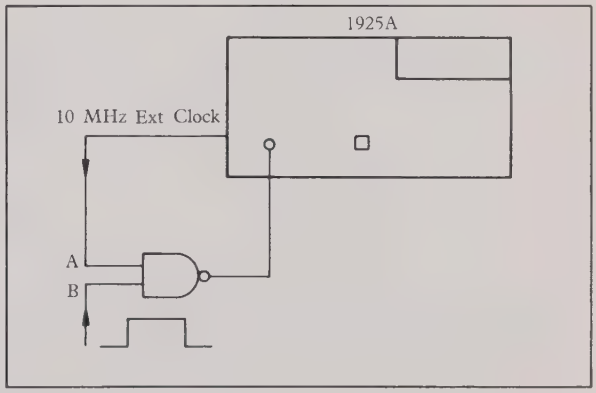


Figure 15.

APPLICATION 4-4

Elapsed Time Using Totalize

While the 10 ns resolution of application 4-3 is outstanding, it can be too much for some measurements. The solution to this is to reduce the frequency counted.

With an input frequency of 1 kHz, each pulse totalized represents an elapsed time of 1 millisecond. To read minutes, change input frequency to 1.6667 kHz, the display will read in milliminutes. These lower frequencies will fill the display more slowly.

If your only signal source is an inexpensive function generator, it should be set to frequency using the counter in its frequency mode.

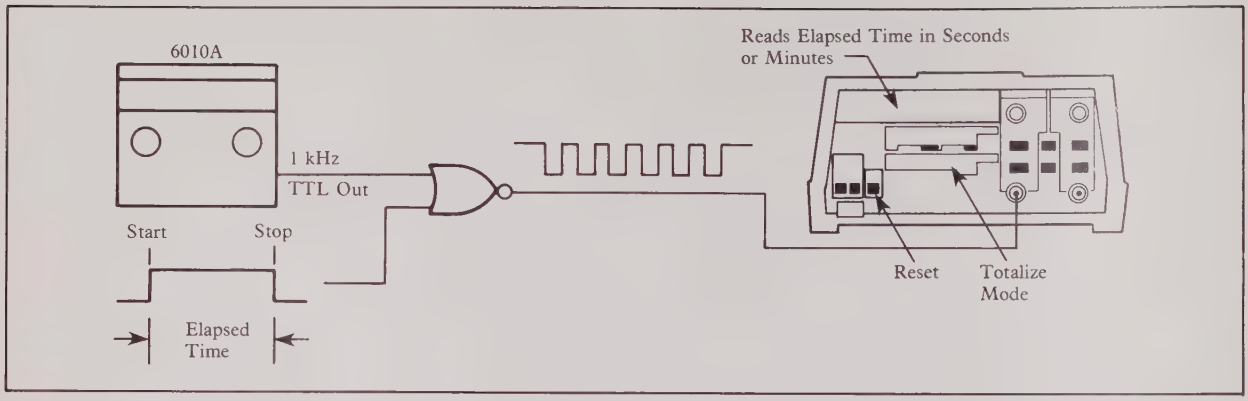


Figure 16. ELAPSED TIME USING TOTALIZE MODE

Section 5
Time Interval Measurements

General Notes

The time interval function is used to measure the time between two selected points on a waveform or the time between selected points on two separate waveforms. Time interval measurements require two separate input channels with separate circuitry for triggering levels, polarity and slope. Refer to Figure 17.

The main gate is opened by input A and closed by input B. During the time the main gate is open, the counter is counting its own internal oscillator.

The time interval mode is a most versatile and useful counter mode but it is not available on all counters because of the additional circuitry that is required is costly. Usually counters that offer time interval are referred to as Universal Counter Timers.

Some applications for time interval measurements include: delayed sweep calibration of scopes, digital circuit evaluation, and cable length measurements by pulse propagation time measurements.

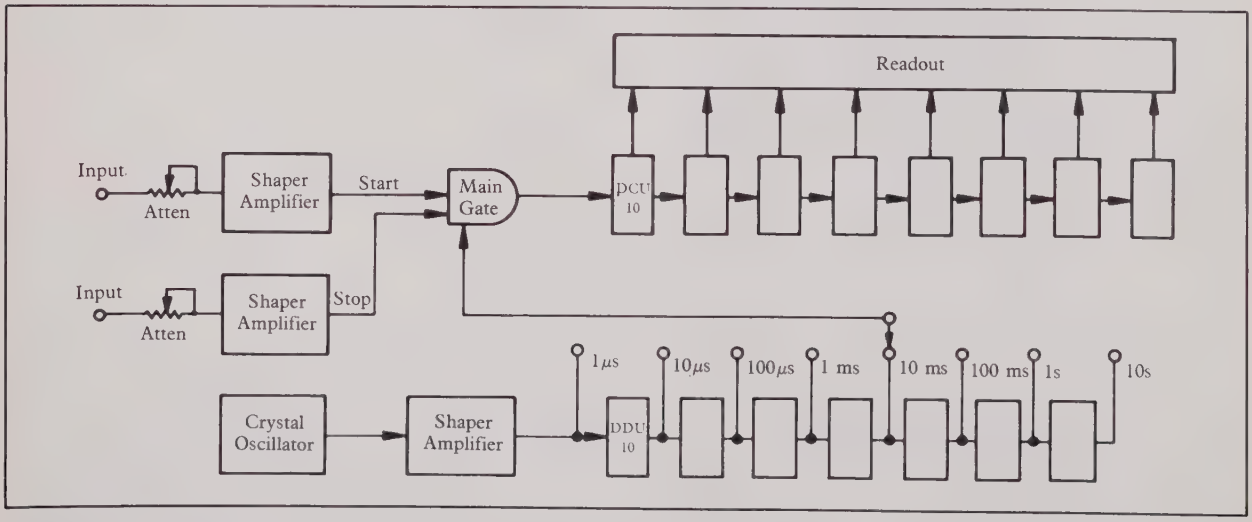


Figure 17. TIME INTERVAL

APPLICATION 5-1

Time Interval Using Scope B Gate

A delayed sweep oscilloscope and a 7250A Universal Counter Timer can be used together to measure the time duration of various parts of complex signals. The intensified portion of the trace is exactly positioned over

the signal to be measured. The time interval of the oscilloscope's "B Gate Out" as measured on the 7250A, will then equal the duration of the complex signal.

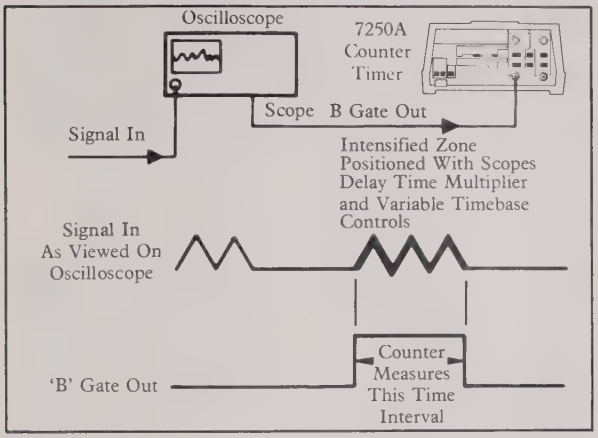


Figure 18.

APPLICATION 5-2

Time Delay Measurements with Scope Time Delay Multiplier

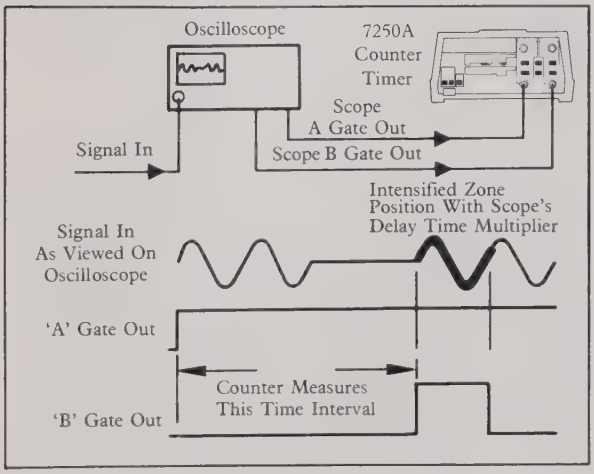


Figure 19.

The above diagram illustrates a technique to measure precisely the time from the beginning of an oscilloscope sweep time to any other point on the sweep. The technique requires an oscilloscope with "A Gate Out" and "B Gate Out" as well as delayed sweep. The counter, a Fluke 7250A, has 100 s resolution in the time interval mode.

APPLICATION 5-3

Using the Marker Output

To enhance trigger level setting accuracy for time interval measurements, use the marker output of the 7260A in conjunction with a dual trace oscilloscope. As the diagram shows, the signal displayed on the oscilloscope will represent the time interval being measured by the 7260A. You may change the trigger points by varying the trigger controls on the counter.

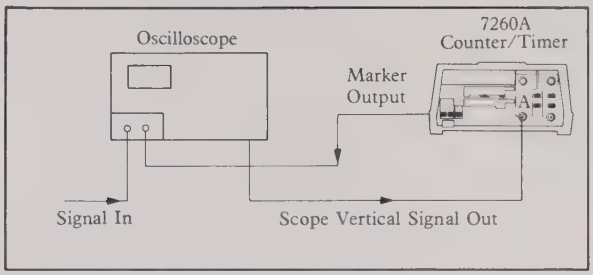


Figure 20. INTERCONNECTIONS FOR MARKER USE

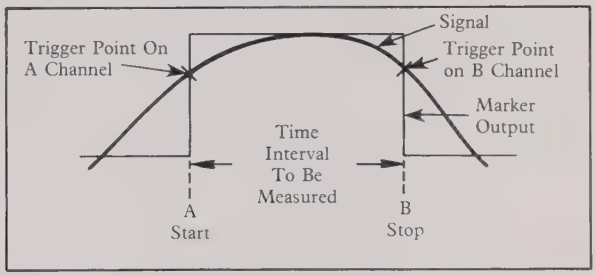


Figure 21. MARKER & SIGNAL

APPLICATION 5-4

Time Interval Using Dual Trace Scope In "Add" Position

A universal counter, when combined with a dual trace, delayed sweep oscilloscope, can precisely measure the period, width, or time interval between non-adjacent pulses of any waveform. An oscilloscope alone can perform these measurements, of course, but not with the accuracy of a counter. On the other hand, the counter input is "blind" and does not know which region of the waveform to measure. Uniting both instruments makes a superior measurement system.

For a scope to measure the period, width, or time interval between two given points of a specific waveform, the scope must isolate the interval of interest and so provide the gating necessary for counting. Thus a scope with a delayed sweep option is required.

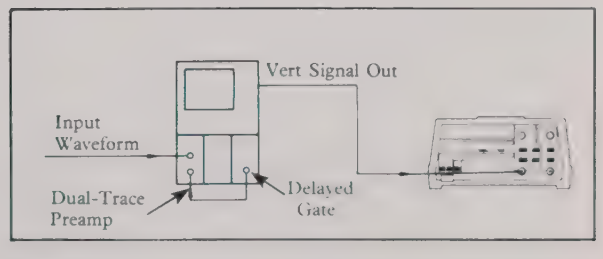


Figure 22.

Counter/Scope used to perform more types of measurements, more accurately, on waveforms than either instrument alone.

As shown in Figure 22 the delayed-gate output of the scope (whose pulse width and position are identical to the portion of the input waveform that's intensified) is connected to one of the vertical input channels and the waveform to be measured to the other. The scope is then placed in the input channels algebraic-add mode. With the scope's horizontal-mode switch in the intensified position, the portion of the waveform of interest is then selected with the delay-time multiplier control. The section of input waveform that the user has chosen to intensify will be elevated above ground potential (Figure 23). It is then a simple matter to adjust the counter's threshold control to trigger at a selected point on the elevated section of the waveform appearing at the scope's vertical signal output port.

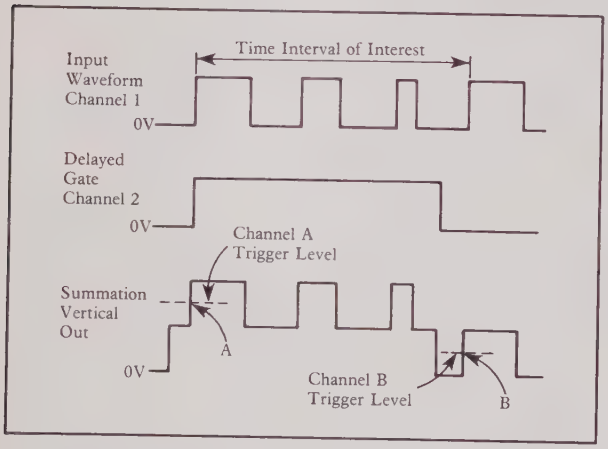


Figure 23.

Section 6
Ratio Measurements

General Notes

The ratio function is used to measure the frequency ratio of two input signals. One signal is coupled into Channel A, the other into Channel B, as in the diagram below.

Assume that the counter must measure the time between points A and B as shown in the above diagram. Place the counter in its time interval mode, and make sure that channel B of the counter will not trigger until channel A has done so. The threshold of each channel is set so that the rising edge of the elevated waveform triggers channel A of the counter, and channel B triggers after the end of pulse has returned to its normal level. Thus the noisy section of pulses contained in the elevated waveform will then be ignored by the counter.

APPLICATION 5-5

Time Interval Hold-Off

If you wish to measure the time of a contact from close to open, this may be made using a 7260A or 7261A counter. Without time interval hold-off, the time interval between A to B in the above diagram, would be measured. With T.I. hold-off, the initial bouncing can be ignored, and the time from A to D, or close to open, can then be measured.

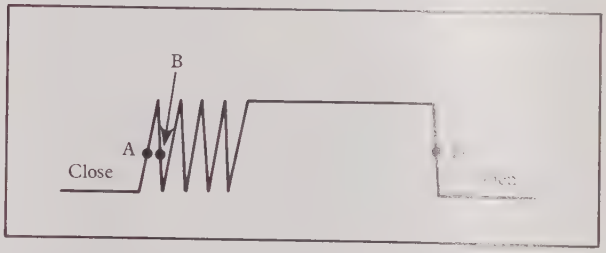


Figure 24.

Usually the higher frequency will be applied to the A input and the lower frequency to the B input. Ratio measurements are accomplished by using B input to open and close the main gate, and counting the A input. Example: if the two input frequencies were 1 MHz and 1 kHz, 1 kHz would be connected to the B input and the 1 MHz signal to the A input. The main gate would then be gated on for $\frac{1}{1000}$s or 1 ms, during which 1000 pulses

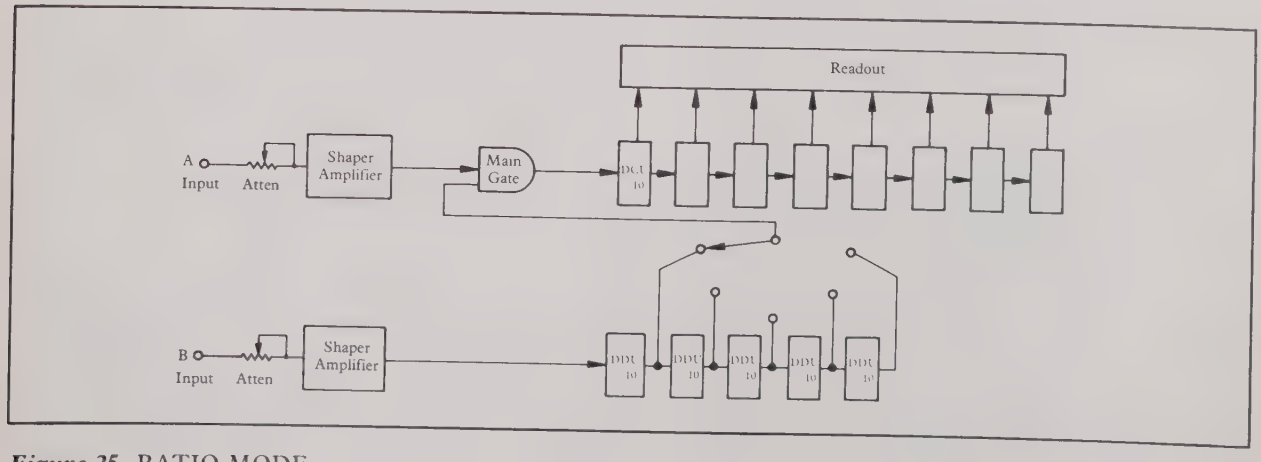


Figure 25. RATIO MODE

of 1 MHz would pass through the main gate. The readout would display 1000, which would indicate a ratio of 1000 to 1.

APPLICATION 6-1

Ratio Mode for Checking ÷ N Dividers

Checking the frequency dividing function of programmable dividers (like the one in the phase locked loop circuit of Figure 25) is an easy job for the ratio function. To test the divider ratio, connect the divider-in signal to the A input of the counter and the divider-out signal to the B input of the counter. After selecting the ratio function the counter will then display the ratio of the two frequency. This will equal the actual division ratio.

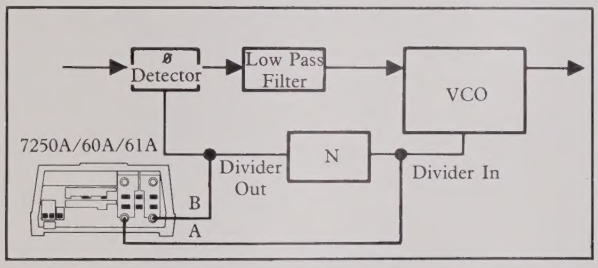


Figure 26.

APPLICATION 6-2

Frequency Ratio Using Ext Clock Input

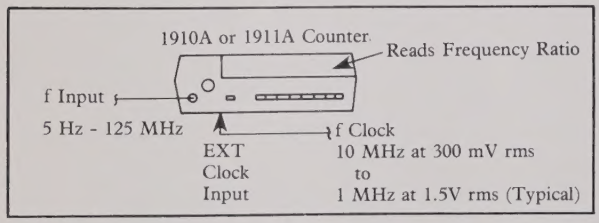


Figure 27.

If your counter does not have a ratio function, the external clock input may be used to implement ratio. Put the input nearest to 10 MHz in the clock input and the other signal in at the front panel. Select the frequency function and read the display. The relationship between the two frequencies and the display is:

$$\text{Display} = \frac{\text{f input} \bullet 10\ \text{MHz}}{\text{f clock}}$$

Examples: 60

f input	f clock	Display	
60.0 Hz	1.0 MHz	.06000 kHz	.01 Hz
111.1 Hz	888.88 kHz	1.250 kHz	resolution!
2.2 MHz	7.0 MHz	3.1429 MHz	
123.45 kHz	6.54321 MHz	188.669 kHz	

Ratio mode is often used to provide greater resolution than normally available in the frequency mode. In the first example the 1.0 MHz external clock expands the maximum gate time to 100 seconds providing .01 Hz resolution.

There are a few things to keep in mind with this application:

1) The external clock has only limited bandwidth, perhaps 10 MHz ± 1 MHz. For our example the clock input is 10 MHz ± 1 MHz and − 9 MHz.
2) The external clock input usually needs TTL levels to work properly and keep measurement errors for a minimum.

Section 7
Industrial Applications

APPLICATION 7-1

Measuring RPM

Use the direct input and select FREQ mode with 1 Hz resolution (1 second gate time). 60 pulses per revolution will make the counter read directly in RPM with correct decimal. The 60 tooth wheel and transducer combination can be purchased from Dynapar Corp., Gurnee, IL 60031. NOTE: Magnetic transducer pulses are sometimes noisy. Use the Attenuator and Trigger Level Control to minimize this problem, and if necessary use a low-pass filter such as the Y7201 on the 1 KHz range.

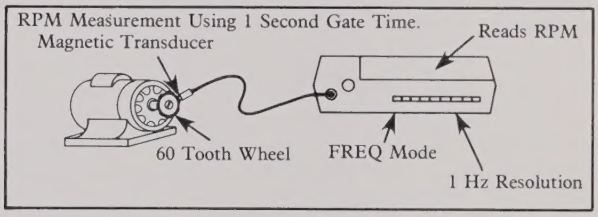


Figure 28.

APPLICATION 7-2

Scaled Readout Using Variable Ext Clock Input

Using a variable timebase for the EXT CLOCK input, the counter display can be made to read out directly in industrial units of feet/min, gallons/hrs, etc. In the below example, the counter is providing a direct readout of surface velocity of the conveyor belt. *The external clock frequency is calculated as follows:*

$$\text{Velocity} = V = 2\pi r \bullet \text{rpm} \quad \text{(feet/min)} \quad (2)$$

where r = drive pulley radius in feet

$$\text{f input} = \frac{\text{rpm}}{60} \bullet N\ \text{(Hz)} \quad (3)$$

If we let Display = Velocity and substitute equations (2) and (3) into equation (1) from Application Note 6-3 (1), the result is:

$$\text{f clock} \quad \frac{N}{120\pi r}\ \text{(MHZ)} \quad (4)$$

Example:

N = 100, rpm = 60, r = 1 ft

Velocity = (2π) (1) (60)

= 376.99 ft/min

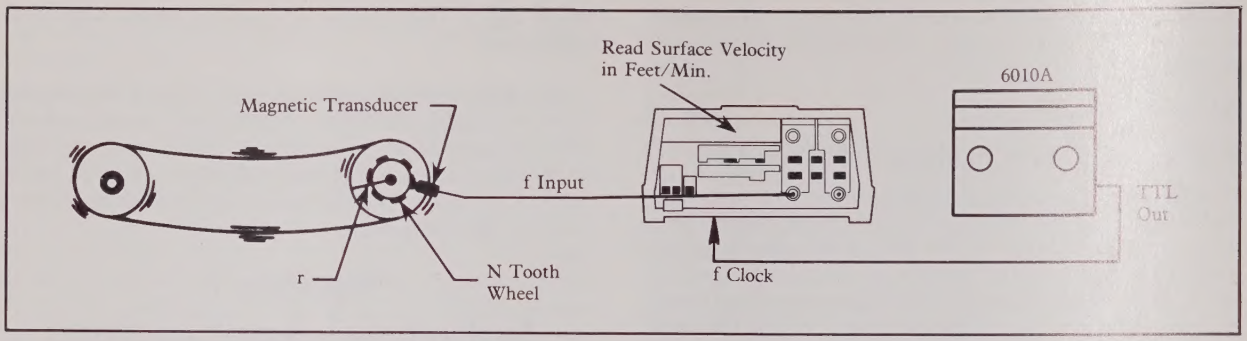


Figure 29.

The counter will read .377 kHz (kilo feet/min) if the external clock frequency is 2.65257 MHz. This frequency is calculated using equation (4) as follows:

$$f\ clock = \frac{(100)}{(12)\ (3.1416)\ (1)}\ MHz$$

$$= 2.65257\ MHz$$

APPLICATION 7-3

Measuring Frequency Using 80I-600 Current Probe

The clamp on probe is a good way to measure frequencies on a large voltage signal. This method not only isolates the counter from the high voltage but also attenuates noise commonly found on high voltage signals. Connect as in the diagram below with a resistor to give an input voltage to the counter within its sensitivity range. You can then read out the frequency on the counter.

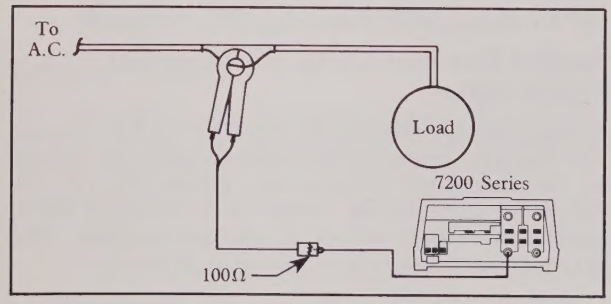


Figure 30.

APPLICATION 7-4
Measuring RPM With 7250/60/61A

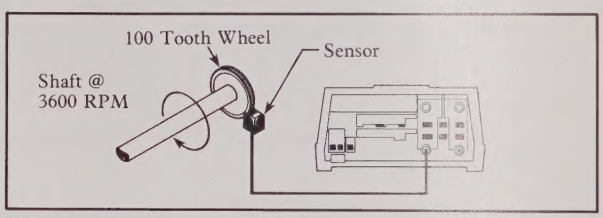


Figure 31.

RPM measurements can be made on a 100 tooth wheel easily using a 7250, 60, or 61A counter.

If a shaft is turning at 3600 RPM, as in the diagram above, with a 100 tooth wheel, the sensor output is 360,000 pulses/min. Dividing this by 60 to get pulses/sec = 6000 pulses/sec.

You may prove the counter reading by feeding in 6 kHz and then place the function slider in the CPM mode — the counter will read 3600.

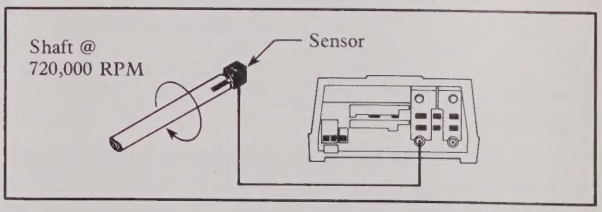


Figure 32.

The sensor output will be 720,000 pulses/min, dividing this by 60 = 12,000 pulses/sec. If you put 12 kHz input to the counter in the CPMx100A mode, it will display 7200 (not 720,000). This is because this mode is set up to work in conjunction with the 100 tooth wheel in Figure 31.

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